Excavations at the Arroyo Site, 42Ka3976: A Pueblo II/III Virgin Anasazi Farmstead

Douglas A. McFadden

With Contributions By:
David Van Alfen, Linda Scott Cummings, Barbara W. Frank,
Steve L. Martin, Lis T. Nauta, Laureen Perry, Carolyn Z. Shelton

Utah Cultural Resource Series No. 27
Grand Staircase-Escalante National Monument Special Publication No. 3

Excavations at the Arroyo Site, 42Ka3976: A Pueblo II/III Virgin Anasazi Farmstead

Douglas A. McFadden

With Contributions By:
David Van Alfen, Linda Scott Cummings, Barbara W. Frank,
Steve L. Martin, Lis T. Nauta, Laureen Perry, Carolyn Z. Shelton

Utah Cultural Resource Series No.27
Grand Staircase-Escalante National Monument Special Publication No.3
United States Department of the Interior
Bureau of Land Management
Salt Lake City, Utah
2012

BUREAU OF LAND MANAGEMENT
UTAH STATE OFFICE
SALT LAKE CITY, UTAH

CULTURAL RESOURCE SERIES – PUBLISHED MONOGRAPHS

1. Richard A. Thompson. *A Stratified Random Sample of the Cultural Resources in the Canyonlands Section of the Moab District.* (1979)

2. Richard E. Fike and John W. Headley. *The Pony Express Stations of Utah in Historical Perspective.* (1979)

3. F. R. Hauk. *Cultural Resource Evaluation in Central Utah, 1977.* (1979)

4. F. R. Hauk. *Cultural Resource Evaluation in South Central Utah, 1977-1978.* (1979)

5. P. R. Nickens, A. D. Reed, S. L. Larralde. *Sample Inventories of Oil and Gas Fields in Eastern Utah, 1978-1979.* The Cisco Cultural Resource Study by Alan D. Reed and Paul R Nickens and Archaeological Inventory in the Red Wash Cultural Study Tract by Signa L. Larralde and Paul R. Nickens.

6. Dale L. Berge. *Simpson Springs Station, Historical Archaeology in Western Utah, 1974-1975.* (1980)

7. William L. Tennent. *John Jarvie of Brown's Park.* (1981) Reprinted August 1982, September 1984.

8. Anan S. Raymond and Richard D. Fike. *Rails East of Promontory, The Utah Stations.* (1981) Reprinted September 1983

9. L. W. Lindsay, P. R. Nickens, K. L. Kvamme. *Excavations of Two Anasazi Sites in Southern Utah, 1979-1980.* Big Westwater Ruin by LaMar W. Lindsay and Archaeological Investigations at the Kanab Site by Paul R. Nickens and Kenneth L. Kvamme. Assembled by Richard E. Fike and David B. Madsen. (1981)

10. Lloyd M. Pierson. *A Cultural Resource Summary of the East Central Portion of the Moab District.* (1981)

11. S. L. Larralde, S. M. Chandler. *Archaeological Inventory in the Seep Ridge Cultural Study Tract, Uintah County, Northeastern Utah with a Regional Predictive Model for Site Location.* (1982)

12. D. B. Madsen, L. W. Lindsay, M. P. Benson. *Archaeological Investigations in Utah at Fish Springs, Clay Basin, Northern San Rafael Swell & Southern Henry Mountains.* Prehistoric Occupation Patterns, Subsistence Adaptations, and Chronology in the Fish Springs Area, Utah by David B. Madsen; An Archaeological Survey of Clay Basin, Daggett County, Utah, by LaMar Lindsay; The Sitterud Bundle: A Prehistoric Cache from Central Utah by Michael P. Benson and Salvage Excavations at Ticaboo Town Ruin by David B. Madsen. Assembled by David B. Madsen and Richard E. Fike (1982)

13. P. R. Nickens, K. D. Black, J. M. Copeland, S. M. Horvath, Jr. *Contributions of the Prehistory of Southern Utah.* A Summary of the Prehistory of Southern Utah by Paul R. Nickens and An Archaeological Survey of the Central Lisbon Valley Study Tract in the Moab District, San Juan County, Utah by Kevin D. Black, James M. Copeland and Steven M. Horvath, Jr., with a contribution by William A. Lucius. Assembled by Steven G. Baker (1982)

14. D. B. Madsen. *Black Rock Cave Revisited* With Chapters By: P. W. Dean, R. E. Fike, C. W. Fuller, R. N. Homer, J. C. Janetski, K. E. Juell, L. W. Lindsay, T. Pratt. (1983)

15. C. W. Martin, H. J. Armstrong, S. M. Crum, B. J. Kutz, L. A. Wheeler. *Cedar Siding Shelter: The Archaeological Excavation of a Multi-Aspect Overhang in Emery County, Utah.* (1983)

16. Richard E. Fike and H. Blaine Phillips II. *A Nineteenth Century Burial from Northeast Utah* With Chapters By: F. R. Hauck, P. R. Nickens, D. D. Scott, L. N. Scott, R. Spraque. (1984)

17. Gardiner F. Dalley and Douglas A. McFadden. *The Archaeology of the Red Cliffs Site.* (1985)

18. J. E. Bradley, W. R. Killiam, G. R. Burns, M. A. Martorano. *An Archaeological Survey and Predictive Model of Selected Areas of Utah's Cisco Desert.* (1986)

19. K. D. Black and M. D. Metcalf. *The Castle Valley Archaeological Project: An Inventory and Predictive Motel of Selected Tracts.* (1986)

20. Barbara A. Walling, R. A. Thompson, G. F. Dalley, D. G. Weder. *Excavations at Quail Creek* With Ancillary Studies by K. M. Heath and L. W. Lindsay. (1986)

21. D. A. Westfall, W. E. Davis, E. Blinman. *Green Spring: An Anasazi and Southern Paiute Encampment in the St. George Basin of Utah* With Ancillary Studies by G. J. Edwards, R. H. Hevly, J. I. Mean and M.G. Taylor. (1987)

22. Betsy L. Tipps. The Tar Sands Project: *An Inventory and Predictive Model for Central and Southern Utah* With Sections by W. A. Lucius, K. W. Russell, A. R. Schroedl, and C. S. Smith. (1988)

23. G. F. Dalley and D. A. McFadden. *The Little Man Archaeological Sites: Excavations on the Virgin River near Hurricane, Utah* With Sections by J. B. Howard, R. A. Thompson, and B. A. Walling. (1988)

24. V. M. Atkins. *Anasazi Basketmaker: Papers from the 1990 Wetherill – Grand Gulch Symposium.* Edited by Victoria M. Atkins, Designed by Lisa McClanahan. (1993)

25. Phil R. Geib, Jim H. Collette, and Kimberly Spurr. *Kaibabitsinungwu: An Archaeological Sample Survey of the Kaiparowits Plateau.* (2001)

26. Barbara A. Walling and Richard A. Thompson. *Archeology of the Dead Raven Site.* With Contribution by Kathleen M. Heath. (2004)

27. Douglas A. McFadden. *The Arroyo Site, 42Ka3976: A Virgin Anasazi PII/III Farmstead.* With contributions by David Van Alfen, Barbara W. Frank, Steve L. Martin, Laureen Perry, Linda Scott Cummings, Lis T. Nauta and Carolyn Shelton. (2012)

Dedication

Daniel "Wil" Oborn
February 19, 1920 - August 18, 1999

This volume is dedicated to Wil Oborn , Dixie Chapter of the Utah Statewide Archaeological Society.

Contents

Dedication (Daniel "Wil" Oborn Feb.19, 1920 - Aug.18, 1999) i

Table of Contents iii

List of Figures x

List of Tables xiv

Foreword (Marietta Eaton) xvi

Author's Note xvii

Acknowledgments xviii

Abstract xx

Chapter 1 - Introduction 1

Project History 1
Environmental Setting 3
Available Natural Resources 4
Geological Resources 4
Floral Resources 6
Faunal Resources 6
Agricultural Options 6
Climate 6
Overview of Grand Staircase Prehistory 8

Chapter 2 - Previous Research 11

Early Research 11

Recent Research 15
The Gnatmare Site Excavations (42Ka1978) 15
Energy Fuels Nuclear Vermilion Cliffs Project 15
California State University, Long Beach Archaeological Field School 16
Kitchen Corral Wash Burials (42Ka2664) 16
Park Wash Site Excavations (42Ka4280) 16
The Roadkill Site Excavations (42Ka4859) 16
Steward's Site 18 (42Ka5571) 17
One Wall Shelter (42Ka4860) 17
42Ka5628 17
Alluvial Studies in Kitchen Corral 17
BLM Inventory 17
Research Orientation 18

Archaeological Research Design for Data Retrieval at the Arroyo Site – 42ka3976 18

Project Background 18
Previous Research and Orientation 19
Specific Research Objectives/Methods 20
Subsistence 20

Ethnicity 20
Site Spatial Structure 20
Ceramic Issues 21
Burial 21
Field Methods 21
Utah Prehistory Week 22
Future Protection and Mitigation 22

Chapter 3 - The Excavations 23
The Feature System 23
Excavation Methods and Procedures 23
Site Stratigraphy 27
Stratum 1 27
Stratum 2 27
Stratum 3 27
Stratum 3A 27
Stratum 4 27
Excavation Units and Cultural Features 27
Excavation Unit A 28
Residential Room 1 28
Fill of West Remnant 28
Description of East Remnant 30
Evidence for Pre-Residential Room 1 Occupation 33
Storage Room 1 34
Storage Room 2 35
Extramural Features 36
Descriptive Summary 37
Excavation Unit B 37
Pit Structure 1 39
Feature 4 40
Descriptive Summary 42
Excavation Unit C 48
Pit Structure 3 48
Pit Structure 4 50
Feature 40 Surface 52
F6 Hearth 53
Descriptive Summary 53
Excavation Unit D 57
Pit Structure 2 59
Descriptive Summary 62

Human Skeletal Remains (H. Hecht, D. McFadden, H. Roberts, S. Underwood) 66
Burial 1 66
Context 66
Inventory 66
Description 66
Burial 2 66
Context 66

Burial 3 67
Context 67
Inventory 67
Description 67
Partial Remains, Pit Structure 3 Fill 67
Context 67
Inventory 67
Description 68
Partial Remains, Pit Structure 4 Fill 68
Context 68
Inventory 68
Description 68
Isolated Human Remains 68

Chapter 4 - Internal Site Dating and Chronology 70
Absolute Dating Methods 70
Excavation Unit A 70
Excavation Unit B 70
Excavation Unit C 71
Excavation Unit D 71
Relative Dating Methods 72

Chapter 5 - The Archaic Level Description and Dating 74
Introduction 74
Site Depositional History 74
Excavation Methods 75
Evidence for the "Pithouse" 75
Pollen and Macrofloral Analysis 76
Macrofloral Analysis 76
Pollen Analysis 77
Dating and Chronology 77
Discussion 78
Future Investigations 79

Chapter 6 - Ceramics (Laureen Perry & David Van Alfen) 81
The Ceramic Assemblage (Laureen Perry) 81
Virgin and Kayenta Anasazi Pottery Types 81
Procedure 83
Re-Fired Sherd Sample 84
Results of Analysis 87
Plain and Corrugated Pottery 87
Black-on-gray/White Pottery 89
Red Ware Pottery 93
Whole and Reconstructed Vessels 95
Site Dating from Pottery 98
Corrugated and Plain Pottery 98
Painted Design Styles 98
Red Wares 98

Overview of 42Ka3976 Ceramics 100
Vessel Assemblage 100
Pottery Manufacture 100
Intrusive Pottery 100
Pottery Distribution 101
Discussion 103
Shinarump Problem 103
Cultural Affiliation 104
Self-sufficiency 104
Summary 105
Intact and Restorable Vessels (David Van Alfen) 106
Inclusions 106
Ceramic Matrix 107
Form 107
Corrugation 108
Painted Decoration 108
Use and Repair 109
Summary and Discussion 109
Miscellaneous Ceramic Artifacts (David Van Alfen) 109
Handles 110
Silty/Temperless Objects 110
Daub 111
Ceramic Disks 111
Scrapers and/or Scoops 111
Puki/Platter 111
Edge-Modified Sherds 115

Chapter 7 - Analysis of Lithic Artifacts (Barbara W. Frank) 116
Chipped Stone Tool Type Definitions and Descriptions 116
Projectile Points 116
Pinto type 117
Rose Spring Corner-notched 117
Parowan Basal-notched 119
Bull Creek 119
Non-diagnostic Arrow points and Fragments 120
Knives and Bifaces 120
Complete knives 122
Knife base fragments 122
Knife tip fragments 123
Knife mid-section fragments 124
Biface fragments 124
Eccentric 125
Preforms 125
Drills 126
Scrapers 126
Bifacially Modified Tools 127
Unifacially Retouched 129
Hammerstones 129
Edge Pounders 130

Core, Cobble, and Flake Scrapers 130
Cobble Scrapers 130
Core Scrapers 130
Flake Scrapers 131
Utilized Flakes 131
Cores 131
Debitage 131
Summary 132
Lithic and Ground Stone Provenience Charts 135

Chapter 8 - Analysis of Ground Stone Artifacts (Barbara W. Frank) 150
Ground Stone Tool Definitions and Descriptions 150
Metates 150
Grinding Slabs 152
Awl Shaper/Sharpeners 152
Manos 153
Two-hand, unifacial, modified, leading-following laterals 154
Two-hand, bifacial, modified, leading-following laterals 155
Two-hand, unifacial, modified 155
One-hand, unifacial, modified, leading-following laterals 155
One-hand, bifacial, modified, leading-following laterals 155
One-hand, unifacial, modified 155
Unifacial, modified, leading-following laterals 155
Bifacial, modified, leading-following laterals fragments 156
Unifacial, modified fragments 156
Bifacial, modified fragment 156
Abrading Stones 156
Unifacial, modified 156
Bifacial, modified 158
Unifacial, unmodified 159
Bifacial, unmodified 159
Polishing Stones 159
Edge Grinders 160
Cobble and Flake Abraders 160
Cobble Abraders 160
Flake Abraders 160
Modified Stone 161
Disks 161
Hatch Cover 162
Modified/Shaped Stone 163
Spheres 163
Hoe 164
Miscellaneous Ground Stone Objects 164
Ground Stone Fragments 165
Additional Rocks and Minerals 165
Summary 166

Chapter 9 - Faunal Remains (Lis T. Nauta) 167
Mammals 167
Class – Mammalia 167
Small Artiodactyla – Deer, Mountain Sheep, Pronghorn 167
Family Cervidae – Deer, Elk 167
Family Bovidae – Cow, Bison, Mountain Sheep 169
Family Antilocapridae – Pronghorn 169
Family Canidae – Wolf, Dog, Fox, Coyote 169
Family Erethizontidae – Porcupine 169
Family Sciuridae – Squirrels 169
Family Leporidae – Rabbit and Hare 169
Birds 169
Class – Aves 169
Family Meleagridae – Turkey 169
Reptile 170
Class – Reptilia 170
Order Lacertalia – Lizards 170
Cultural Modification 170
Discussion and Conclusions 170
Modified Bone 171
Description of Awl Types 172
Type I, Head of Bone Split Awls 172
Type II, Distal End of Bone Split Awls 172
Type III, Splinter Awls 172
Type IV, Bird Bone Awls 172
Type V, Tip Fragments 172

Chapter 10 - Macro-botanical Analysis (Steve L. Martin) 174
Methods 175
Results 176
Column Sample 176
Hearths 178
Floor Contacts 178
Feature Fill 180
Discussion 182

Chapter 11 - Pollen Analysis (Linda Scott Cummings) 186
Methods 186
Ethnobotanic Review 187
Discussion 191
Summary and Conclusions 194

Chapter 12 - Summary and Discussion 196
Chronology 196
Architecture 196
Regional Comparisons 197

Surface Residential 197
Subterranean Pit Structures 197
Miniature Pit Structures 197
Intra-Site Architectural Variability 197
Residential 197
Storage 198
Temporal Change 199
Ceramics 199
Summary 200
Technology 201
Projectile Points 201
Spindle Whorls 201
Subsistence 202
Discussion 202
Midden: Its Not Just Trash 203
Mortuary Practices and Processes 203
Summary and Discssion 204
Ethnicity 204
Demography 205
Virgin Adaptive Behavior 205

Epilogue: The GSENM Kanab Visitor Center Concept (Douglas McFadden and Carolyn Z. Shelton) 207
The Archaeological Concept 207
The Excavation Diorama 207
The Science 208
The Excavation Diorama 209
Additional Exhibit Cases 214
The Mural, Circa 1100 AD 214
The Archaeological Timeline 214
The Ceramic Sequence 215
The Mother of All Map Models, or...The Cartographic Wonder 217
Educational Programming 217
Summary 218

References 220

Appendix - Calibration of Radiocarbon Age to Calendar Years 233

List of Figures

Figure 1.1 Location Map 1

Figure 1.2 The Arroyo Site, overview 2

Figure 1.3 The Arroyo Site, pre-excavation detail view of the wash 2

Figure 1.4 Kitchen Corral Wash,; view north towards the confluence of Park Wash and Deer Springs Wash 3

Figure 1.5 Stratigraphic Column of bedrock exposed in the Kitchen Corral drainage 5

Figure 1.6 Local thunderstorm, facing south from the Arroyo Site 7

Figure 1.7 Formative Temporal periods 9

Figure 2.1 Julian Steward's sketch map of sites recorded in 1932 12

Figure 2.2 Julian Steward's Site 48, Kitchen Corral Wash 13

Figure 2.3 Selected sites in the Kitchen Corral area, eastern Grand Staircase 14

Figure 3.1 Plan, contour, and excavation map of 42Ka3976 24

Figure 3.2 Excavation unit/arroyo profile drawings 25

Figure 3.3 In progress view of Excavation Unit A., facing southeast 28

Figure 3.4 Plan map of Excavation Unit A 29

Figure 3.5 Initial definition of Residential Room 1, east remnant, facing east 30

Figure 3.6 Final definition of Residential Room 1, east and west remnants, facing west 30

Figure 3.7 Detailed view of Residential Room-1 Hearths A and B, partially excavated 31

Figure 3.8 View of Residential Room 1 fill, west remnant 31

Figure 3.9 Cross section of Residential Room 1, east wall Excavation Unit A 32

Figure 3.10 View of F37 fill north (on left) of Residential Room 1 floor 33

Figure 3.11 View of F-F' profile in arroyo cut, Residential Room 1 floor on left 34

Figure 3.12 Drawing of F-F' profile 34

Figure 3.13 View of Storage Room 1 floor pavement 35

Figure 3.14 View of Storage Room 2 facing southeast with floor clay partially removed 35

Figure 3.15 View of Excavation Unit B, facing northeast 37

Figure 3.16 Cross section of Pit Structure 1 as exposed in the arroyo 38

Figure 3.17 Plan map of Excavation Unit B and Pit Structure 1 38
Figure 3.18 View of Pit Structure 1, facing northeast 41
Figure 3.19 Detail of Pit Structure 1 northeast wall with masonry and ash lens above 41
Figure 3.20 Detail of Pit Structure 1 hearth, partially excavated 42
Figure 3.21 Pre-excavation view of Feature 4, note restorable vessel and door slab 43
Figure 3.22 Feature 4 niche/tunnel with in situ vessels 43
Figure 3.23 View of Excavation Unit C with Stratum A removed, note F40 surface and Pit Structure-3 in profile 48
Figure 3.24 Excavation Unit C plan map 49
Figure 3.25 Cross-section of south wall, Excavation Unit C 50
Figure 3.26 Cross-section of west wall, Excavation Unit C 50
Figure 3.27 Cross-section drawing of Pit Structure 3 fill exposed in arroyo cut 51
Figure 3.28 Final definition of Pit Structure 3 51
Figure 3.29 Excavation Unit C, Pit Structure-4 excavation in progress 52
Figure 3.30 Final definition of Pit Structure-4, Pit Structure 3 and F40 surface 52
Figure 3.31 Profile drawing of arroyo cut profile G-G' 53
Figure 3.32 Detail view of F6 hearth, partially excavated 54
Figure 3.33 View of Excavation Unit D, removing Stratum 1 57
Figure 3.34 Plan and cross section of Pit Structure 2 58
Figure 3.35 Vertical view of Excavation Unit D, defining Pit Structure 2 59
Figure 3.36 Profile of Pit Structure 2 fill exposed in east wall of Excavation Unit D 60
Figure 3.37 Pit Structure 2, final definition 61
Figure 3.38 Pit Structure 2, detail view of hearth and deflector 61
Figure 4.1 Calibrated radiocarbon ranges 72
Figure 4.2 Schematic profile of feature relationships 73
Figure 5.1 Plan map of Archaic exposures 75
Figure 5.2 Arroyo wall, profile A-A' 76
Figure 5.3 Arroyo cross section B-B' 76
Figure 5.4 Collection charcoal from F34 surface. Note milling slab on south end 77
Figure 5.5 Detail of milling slab from F34 surface 78

Figure 5.6 Array of Selected Radiocarbon Dates on the Grand Staircase (Late Archaic – Transitional) 79

Figure 6.1 Intact and restored bowls: (A) Wygaret B/G; (B) Wygaret B/G; (C) Orderville B/W; (D) North Creek B/G; (E) North Creek B/G; (F) Hildale B/G; (G) Middleton Red (Shinarump); (H) Wahweap B/G 96

Figure 6.2 Intact Jars, Vessel Type: (A) Local Corrugated Canteen; (B) Local Corrugated Jar; (C) Unidentified B/G Mug 97

Figure 6.3 Translational elements of bowl designs from 42Ka3976 (letters refer to figure 6.1) 99

Figure 6.4 Unperforated ceramic disks 112

Figure 6.5 Perforated ceramic disks 113

Figure 6.6 Modified sherds 114

Figure 6.7 Puki/Platter fragments 115

Figure 7.1 Projectile points. A, Pinto dart point; B, Rose Spring Corner-notched; C-I, Parowan Basal-notched; J-M, Bull Creek; N, Unidentified corner-notched 118

Figure 7.2 Knives and bifaces. A-C, fragments; D-E, hafted knives; F-H, Knife base fragments; I-K, knife tip fragments; L, preform 121

Figure 7.3 Drills. A-D, hafted drills; E, bifacially modified tool 127

Figure 8.1 Metates. (A) slab, (B) trough 151

Figure 8.2 Selected ground stone:(A) awlshaper; (B-E) manos. 153

Figure 8.3 Selected abrading stones 157

Figure 8.4 Dressed sandstone slab 164

Figure 9.1 Fauna from the Arroyo site 168

Figure 9.2 Modified bone awls and needles 173

Figure 11.1 Pollen diagram 189

Figure 13.1 Utah Prehistory Week: school children above Excavation Unit B (courtesy of Southern Utah News) 208

Figure 13.2 Reconstruction of Pit Structures 2 and 3 covered in paper 210

Figure 13.3 Reconstruction of Pit Structures 2 and 3 covered with concrete stucco 210

Figure 13.4 Completed diorama of Pit Structure 2 211

Figure 13.5 Completed diorama of Pit Structure 3 211

Figure 13.6 Completed excavation diorama 212

Figure 13.7 Display of archaeological techniques 212

Figure 13.8 Display of archaeological relative dating methods 213
Figure 13.9 Display of archaeological analysis methods 213
Figure 13.10 Display case containing rare hand-plaited rabbit net and snare 214
Figure 13.11 Temporary display case 214
Figure 13.12 Photograph of mural "A Day in the Life" 215
Figure 13.13 Time line 215
Figure 13.14 Ceramic vessels display 217
Figure 13.15 Three-dimensional tabletop terrain model 218

List of Tables

Table 3.1 Pit Structure 1 Artifact Catalog....44

Table 3.2 Pit Structure 3 Artifact Catalog....55

Table 3.3 Pit Structure 4 Artifact Catalog....56

Table 3.4 Pit Structure 2 Artifact Catalog....62

Table 3.5 Summary of isolated human remains....68

Table 3.6 Element alaysis of isolated human remains....69

Table 4.1 Radiocarbon dates....71

Table 5.1 Radiocarbon Dates from the Archaic level....77

Table 6.1 Total sherd counts and total sherds analyzed for 42Ka3976....84

Table 6.2 Re-fired sherd sample from 42Ka3976....85

Table 6.3 Temper types and clay shadings in corrugated and plain potsherds from 42Ka3976....88

Table 6.4 Temper types in painted potsherds from 42Ka3976....91

Table 6.5 Design styles and elements on painted potsherds from 42Ka3976....92

Table 6.6 Design styles and elements on red ware potsherds from 42Ka3976....95

Table 6.7 Distribution of potsherds by type found in contact with floors and bench at 42Ka3976....102

Table 7.1 Lithic material type definitions....117

Table 7.2 Debitage material type summary....133

Table 7.3 Percentage of cortex present on debitage material type....133

Table 9.1 Number of identified specimens (NISP), percent NISP, and minimum number of individuals (MNI) for skeletal elements identified to the species level....168

Table 9.2 The NISP count and percent of the skeletal elements identified to only the order level....168

Table 9.3 Modified bone proveniences....172

Table 10.1 Identifiable taxa recovered from the Arroyo Site flotation samples....177

Table 10.2 Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights for the column sample from Pit Structure 1 fill....179

Table 10.3 Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights for the hearth samples....181

Table 10.4 Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights for the floor contact samples 183

Table 10.5 Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weightsa for the feature fill samples 185

Table 11.1 Provenience data for samples from site 42Ka3976 187

Table 11.2 Pollen types observed in samples from site 42Ka3976 192

Table 13.1 Behaviors portrayed in the Arroyo Site Mural 216

Foreword

The publication of this volume brings to closure a process begun in 1993 when Doug McFadden realized an opportunity that has now been fulfilled. With the designation of Grand Staircase-Escalante National Monument (GSENM) I arrived as a virtual novice to the area and was fortunate to work with the author. Although trained as an archaeologist it soon became apparent that I would never, in this lifetime, come to the comprehensive understanding of the Virgin Anasazi that Doug McFadden possessed after decades of work in the area. This book report represents Doug's passion for archaeology and his determination and commitment to learning everything that he could about the prehistory of the region.

Early on in the process of planning for GSENM McFadden recommended that for science and interpretation the Monument concentrate some efforts in Kitchen Corral Wash, where the Arroyo site is located. Because of the easy access from Highway 89 and the accumulation of scientific archaeological information that was already available at the Arroyo site, a perfect story was awaiting illumination.

When the time arrived to design the four visitor centers in communities surrounding the Monument it was natural to pursue the vision that Doug suggested, and under his imaginative guidance a replication of excavations at the Arroyo site came to life in a very tangible way. The idea of using an actual archaeological site model to interpret the science of archaeology proved to be inspired. As the culmination of this ancient story the publication of this book report articulates in detail the context of the Arroyo site, and new insights and discoveries revealed in the necessary detail of a scientist. Although many individuals contributed to this volume, it was only through the foresight provided the author that the dream came to fruition.

McFadden, an archaeologist's archaeologist, brings to life not just the specific details about prehistoric Archaic and Virgin Anasazi use of the site, but the behaviors that the material record reveals as well as the new questions that any excavation create. The Arroyo site is but one snapshot into the prehistory of the region but through the compilation of this tome McFadden has completed the entire process surrounding the excavation of a site and its broader regional interpretation. The meticulous reconstruction required by a serious archaeologist is well articulated and now tangible to any one with a serious interest in the past. For any fan of archaeology this volume and the exhibits it inspired will provide a detailed scene of life nine centuries ago near Kanab, Utah.

Recently retired from BLM after a long and dedicated career it is safe to say that few federal archaeologists have pursued their profession with such dedication and a continued allegiance to the discipline as Doug McFadden. This work now stands as a hallmark for professional archaeologists working in and outside of BLM.

Marietta Eaton

Author's Note

The term "Anasazi" is used by the author and contributors throughout this volume. It was coined in the 1920's by archaeologists to describe a temporal and geographically defined archaeological culture and contrast that culture with others in the Southwest. The word Anasazi is derived from the Navajo term Anaasa' zi which loosely defined means "ancient enemies" (Walters and Rogers 2001).

The Hopi prefer their term "Hisatsinom" which means "ancient ancestors" – thus emphasizing their view of the past. Recently archaeologists and government agencies in the Four Corners area have encouraged using the term Ancestral Puebloan. In fact, the entire Monument area and the region surrounding it is historically Southern Paiute territory. Members of the local Paiute bands have their own perspective on the past and many of them also claim a relationship with the ancient Anasazi.

On the GSENM, several Formative Period groups are found which have been referred to as Kayenta Anasazi, Virgin Anasazi and Fremont. The relationships between these entities has long been a subject of intense study. To refer to them collectively as simply the ancestors of modern puebloans would obscure these relationships. In this volume and elsewhere, for the sake of clarity and consistency with historic useage, the term Anasazi will be used as necessary. It is considered just a word and is used without prejudice.

D. A. M.

Acknowledgments

This volume is dedicated to Daniel "Wil" Oborn. Wil was an extraordinary volunteer associated with the Dixie Jennifer Jack Chapter of the Utah Statewide Archaeological Society (USAS). He learned to dig at the South Gate excavations in St. George under the direction of Gardiner Dalley, and was an invaluable crewmember at the Arroyo site. His enthusiasm and friendship will long be remembered.

I thank Matthew Zweifel for final editing and for picking up the reins to see this volume through to publication and Jerry Spangler, President of the Colorado Plateau Archaeological Alliance, who facilitated hiring Daisy Johnson to complete the challenging task of formatting it.

There are many other volunteers to thank for the assistance they provided. Jim Starr, also a volunteer associated with USAS and the St. George excavations, provided hours of labor removing both overburden as well as digging in the "smart" dirt. Geralyn McEwen of St. George (now the St. George Field Office archeologist) dug her way into a job with the BLM. Volunteers from the Fredonia chapter of the Arizona Archaeological and Historical Society include: Wayne Grosz, Arlene Goodheart, Robert and Rose Wells, and Sheila Alvord.

By happy coincidence, UCLA doctoral candidate Steve Martin, looking for Virgin Anasazi subsistence data to analyze as part of his dissertation, collected the macrobotanical samples. The results are included in this volume as well. Adella Valdez (UCLA), having previously gathered data for her Masters thesis at a nearby 42Ka1568 maintained an interest in the area and volunteered for two weeks.

Human remains, often occurring as isolated bone, were found in a variety of contexts. I'm grateful to Heather Hecht, Heidi Roberts and Sali Underwood for their observations and assistance with identification conducted at the Southern Utah University lab.

Jack Burns, Barbara Frank, and Laird Naylor, all employed by Zion National Park, visited and helped with the excavations. Elizabeth Ambos, Ph.D, Dan Larson, Ph.D., and Mr. Bill Ma of CSULB conducted a pre-excavation experiment in ground penetrating radar. Dr. Kathrine Rigsby and graduate student Thomas Kulp, working on a Masters Degree at Eastern Carolina University, visited the site and eventually incorporated observations made on the Arroyo site into his thesis.

A special thanks to Diana Christensen Hawks of the Arizona Strip District for convincing her office that she should be working with us in Utah rather than at her primary place of work. Also to Kanab Resource Area volunteer Lloyd Averill of Houston, Texas for helping to construct the post excavation debris dams and put the site to bed.

At the time it was excavated, the Arroyo site was located on lands administered by the Kanab Resource Area; thanks to Area Manager Verlin Smith for supporting the project. Also thanks to Garth Portillo Utah State Office archeological program lead for funding a series of radiocarbon dates. In September 1996, the site came under the administration of the Grand Staircase - Escalante National Monument. Thanks to interim Manager Jerry Meridith, Monument Managers Kate Cannon, David Hunsaker, and particularly Assistant Manager for Cultural and Earth Sciences Marietta Eaton, for funding the remaining analyses and the time necessary to write up this report.

I am particularly gratified that Camille Ensle – who initially visited the site while it was under excavation as a Girl Scout in the 7th grade and is now an archaeological technician for the Monument while pursuing a degree in anthropology – has become indispensable during the write-up phase by undertaking the countless computerized tasks necessary to create this report.

Thanks to GSENM staff Matt Betenson who produced the GIS map, Merle Graffam who drew the artifacts, and Carolyn Shelton, Front Country Interpretive Supervisor, who had the vision to proceed with reconstructing the pithouses in the Kanab Visitor Center and co-authored the final section of this volume.

The Arroyo excavation studies were truly multidisciplinary and required expertise in a variety of fields. Contributors include: Barbara Frank

(SUU/Intersearch) who carried out the chipped and ground stone analyses, Laureen Perry (UNLV) wrote the chapter on ceramics, David Van Alfen (U. of A.) described the refitted vessel and ceramic artifact collections, Lis Nauta (BYU) studied the faunal collection, Linda Scott Cummings (Paleo Research) wrote the pollen report, Dr. Steve Martin (UCLA) contributed the marcobotanical studies which were part of his Ph.D. dissertation. These studies were carried out years before the draft excavation report was produced. The principle investigator directed the excavations, structured the volume, and edited these contributions for consistency.

My greatest debt is to Gardiner Dalley – a mentor and friend. Of all the small-scale excavations we worked on together over the years as part of the Kanab "parts and pieces excavation program," the Arroyo site was by far the most ambitious. It couldn't have been done without his help.

D. A. M. 12/31/04

Abstract

This report describes salvage excavations at a Late Pueblo II/III Virgin Anasazi residential site on the eastern Grand Staircase in Kane County. The site, sealed under a meter of post-occupational alluvium, was recently exposed in profile by the sudden down-cutting of a deep arroyo. The arroyo bisected the site exposing a variety of features including: a roomblock with both residential and storage rooms, two subterranean pit structures, several small semi-subterranean rooms, multiple occupation surfaces, and a burial. Excavations revealed a complex history of occupation at the Arroyo site: multiple floors in the storage rooms, multiple occupation surfaces and superpositioned hearths in the surface residential room, the superpositioning of two pitstructures, and the occurrence of trash deposits in all of the pitstructures, indicated multiple episodes of occupation. This evidence is consistent with a previously described site settlement pattern of family groups having the option of shifting among multiple residences.

Radiocarbon dates indicate that the site was initially occupied during the A. D. 1100's and, perhaps intermittantly, well into the thirteenth century - considerably beyond A.D. 1150 usually cited as the terminal date for the Virgin Anasazi based on ceramic cross-dating. The lack of late ceramic types on Arroyo suggests that the region was effectively isolated from the mainstream of Kayenta Anasazi culture during Pueblo III times.

The mix of Virgin and Kayenta architectural, ceramic, and projectile point styles on site suggests that, after a brief period of Kayenta influence the Virgin tradition reasserted itself. Essentially, the local Virgin population simply incorporated the new, largely stylistic traits (and possibly Kayenta migrants themselves), into their existing adaptive system.

Underlying the Puebloan occupation a deeply buried Archaic 'pithouse' was investigated and dated to approximately 1700 B.C. Associated with this structure was a discontinuous lens of charcoal that indicates good potential for future investigations of the Late Archaic period. The implication of these buried horizons is that additional deeply buried sites likely occur along Kitchen Corral Wash.

The final section describes the archaeological theme of the Kanab Visitor Center and how replicas of the Arroyo site pit structures were incorporated into it as part of the Grand Staircase-Escalante National Monument's interpretive program.

Chapter 1
Introduction

The Arroyo site, 42Ka3976, is one of six puebloan archaeological sites recorded in the summer of 1993 during the course of a routine cultural resource inventory conducted by the Kanab Field Office archaeologist. The inventory was carried out prior to a prescribed burn which was designed to eradicate a stand of decadent sage brush; the area burned would then be re-seeded with grasses and forbs. The 100 acre burn area was located on the deep alluvium along Kitchen Corral Wash, a major drainage located in central Kane County, 25 miles east of Kanab (Fig. 1.1).

PROJECT HISTORY

Previous inventory and records for a few of the more obvious Anasazi sites along the wash suggested that the area had a relatively high site density. Virtually all of the known sites prior to the 1993 survey were situated on the terraces and slopes bordering the wash above the sage- choked bottomland. 42Ka3976 was a notable exception to this pattern. It was located on (actually within) the canyon floor alluvium and had been exposed in the banks of a recently cut wash (Figs. 1.2, 1.3).

The vertical walls of the arroyo displayed approximately 40 meters of cultural material that had been sealed under a meter of fine alluvial outwash. On the north end of the cut were remnants of a room block with both storage and residential rooms; downstream to the southeast, originating from the buried occupational surface exposed in both sides of the arroyo, a variety of features were visible

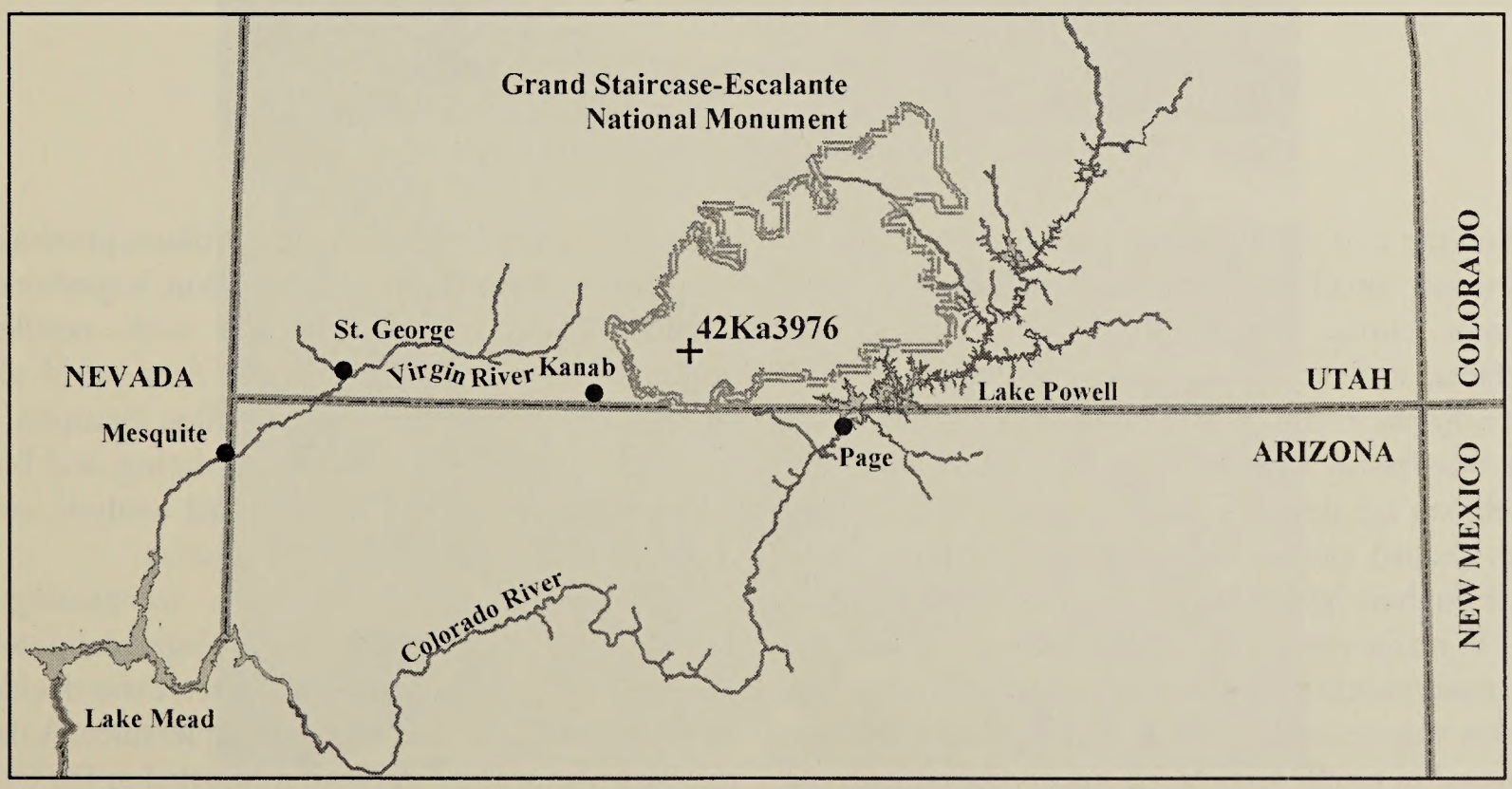


Figure 1.1. Location map

Figure 1.2. The Arroyo site, overview.

Figure 1.3. The Arroyo site, pre-excavation detail view of the wash

including: two deep subterranean pit structures, an extremely small but formal pit structure, a flexed human burial, various small pits, occupational surfaces, and lenses of structural debris. In all, virtually the entire cross-section of a late Pueblo II site was freshly exposed (Fig. 1.3). Underlying the Puebloan age deposits was the profile of a discrete, dish-shaped surface subsequently interpreted as a Late Archaic "pithouse" (McFadden 2000b).

With the site threatened by continued erosion and the unfortunate probability of vandalism, immediate action was necessary. The extremely fragile features exposed in profile were faced-up, photographed, and drawn in the fall of 1993. Ceramics (including one complete vessel), bone, and stone artifacts protruded from many of the features. In addition, impressively stratified, ashy, midden deposits with excellent potential for yielding subsistence data could also be seen in the pit structure profiles. Samples of ceramics, charcoal for radiocarbon dating, and bulk soil samples for macro floral/faunal analysis were collected at the close of the 1993 season.

During the winter of 1994, recognizing a professional responsibility as well as legal mandate to salvage data from the threatened site, it was decided to excavate the exposed and eroding features. A data recovery plan was written and submitted to the Utah State Historic Preservation Office, the Advisory

Council on Historic Preservation and the Kaibab Paiute Tribe (see Chapter 2).

Fieldwork at the Arroyo site was scheduled to begin May 3, 1994 just prior to the public activities of Utah Prehistory Week. After a week of removing overburden and initiating excavation of the features, definition was far enough along to allow an impressive demonstration of archeological methods and the importance of context to both school children and the general public. Fieldwork continued off and on through the summer and fall of 1994. Just over a year after its discovery, the arroyo was "plugged" with two debris dams designed to allow it to naturally refill with sediments and stabilize the banks. In July 2004, interpretive exhibits depicting the Arroyo site were opened to the public at the GSENM Kanab Visitor Center.

Artifacts and samples from the Arroyo site are curated at the Southern Utah University (SUU) archeological repository in Cedar City. Human remains have been inventoried under Native American Graves Protection and Repatriation Act (NAGPRA) provisions and are also curated at SUU.

ENVIRONMENTAL SETTING

Kitchen Corral Wash is one of several significant north-south oriented drainage systems on the Grand Staircase physiographic section (Stokes 1986). The drainage system heads on the Paunsaugunt Plateau at an elevation of approximately 8,600' and flows south to its confluence with the Paria River, 30 miles above Lee's Ferry on the Colorado River. The upper 20 mile segment of this almost entirely dry wash cuts through all of the major formations and cliff lines that make up the Grand Staircase.

By virtue of its natural segmentation, the characteristics of the drainage vary tremendously over its length. The upper end is an expansive dendritic system of both flowing streams and intermittent washes that originate in the Pink Cliffs of the Paunsaugunt Plateau and cut across the Skutumpah Terrace at an elevation of about 7,000'. These tributaries join to form the major branches of Park and Deer Spring Washes as they down-cut through the White Cliffs and across the dry, sandy terrace known as Nephi Pasture. As these two washes cut through the Jurassic age formations (Kayenta and Moenave) of the Vermilion Cliffs, they traverse the 5,000' to 7,000' elevation zone best suited for agriculture on the Grand Staircase (McFadden 1996). Kitchen Corral also provides an important natural corridor for the seasonal movement of big game. Within this optimal zone, the Arroyo site, at 5,560', is well positioned to exploit native species as well as the practice of agriculture. (Fig. 1.4).

Below the Vermilion Cliffs, an expanse of open sage and grassland known as Telegraph Flat and

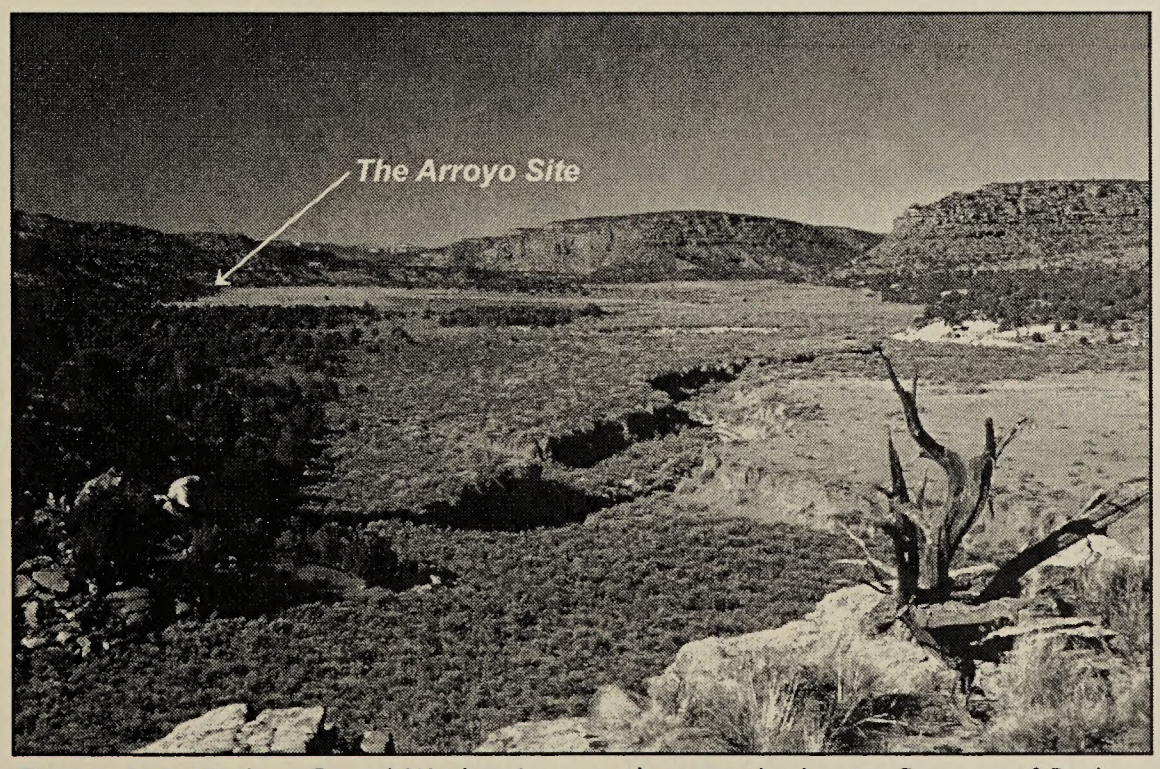


Figure 1.4. Kitchen Corral Wash, view north towards the confluence of Park Wash and Deer Springs Wash.

Kimball Valley extend southward to the pinyon and juniper covered slopes of the Kaibab Monocline. At this point, the Kitchen Corral drainage forms the deeply incised Kaibab Gulch, a gorge with limited agricultural opportunities that cuts through the Permian age Kaibab Limestone. The drainage exits Kaibab Gulch and crosses a narrow strike valley (Coyote Valley) formed by a hogback of Jurassic age sandstone. Exiting Coyote Valley, the wash enters the narrow "slot" canyon of Buckskin Gulch. The Navajo Sandstone walls of the gulch rise hundreds of feet above the narrow canyon. Again, agriculture was not possible but petroglyphs suggest it was used as a travel corridor. Buckskin Gulch enters the Paria River about 30 miles above the Paria's confluence with the Colorado River at Lee's Ferry. The lower reaches of the drainage system, while apparently never a significant agricultural locale, may have been important because it forms a direct route from Kitchen Corral to the Colorado River and the Kayenta Anasazi culture area beyond.

Available Natural Resources

Bounded on the east by the dry and dissected formations of the Kaiparowits Plateau, on the north by the Paunsaugunt Plateau and on the west by the St. George Basin, the Grand Staircase is structured by a series of cliff lines that offer a sequence of elevationally uniform terraces that serve to provide a variety of geological, floral and faunal resources.

The physiography of the Grand Staircase is uniquely structured. Within a span of only 30 miles, elevation ranges from 5,000' on the Utah/Arizona border to over 9,400' at Bryce Canyon National Park. The range of environmental settings within this relatively small area serves to maximize the diversity of geological resources, flora, and fauna and also insures seasonal changes in the availability of big game as well as flora. While the spectacular cliff lines are celebrated, it is the broad terraces in between them that offer a variety of habitats and agricultural opportunities. It also appears that a key consideration for the exploitation of agricultural opportunities by the Anasazi is their size; although isolated farmsteads do occur, the vast majority of residential sites occur in settings where community-sized clusters could practice dry farm or run-off agriculture. Major north – south drainages that bisect the cliff lines, such as Johnson Canyon, Seaman Wash and Kitchen Corral are sources for springs, provide corridors for big game migration, additional agricultural niches as well.

The Arroyo site, located on the alluvial floor of Kitchen Corral Wash, lies at an elevation of 5,560'. Although intermittent, the wash drains a large portion of the Grand Staircase physiographic province. Heading at 9,000' on the Paunsaugunt Plateau, its two main branches (Park Wash and Deer Springs Wash) flow south cutting through the major cliff lines to their convergence just below the Vermilion Cliffs. Below their confluence, the alluvial floor of the canyon widens and forms a zone favorable for agriculture as well as the exploitation of native resources.

Geological Resources

Due to the numerous sandstone formations exposed in Kitchen Corral Canyon, abundant and varied geological resources are locally available (Fig. 1.5). Tabular sandstone as well as blocky material for masonry construction was readily available in the Moenave and Kayenta Formations. A variety of clays, from both primary and residual deposits, are also present. The most abundant local source is the variegated clay from the Petrified Forest Member of the Chinle which was used for construction and possibly for the production of ceramics. Sandstone was also used for the production of manos and metates. The Shinarump Member of Chinle, a coarse, tough conglomerate, was available for milling tools. Silicious stone, suitable for chipped stone tools, was readily available as bedded agate occurring in the Petrified Forest Member of the Chinle. Petrified wood chunks from the same formation were favored for hammerstones and pounding tools. Chert was also available as nodules formed in the Kaibab Limestone Formation exposed in Kaibab Gulch and on Buckskin Mountain. Claron chert originates in the uppermost White Member of the Claron Formation of the Pink Cliffs. The closest known exposure of this material is north of Red Canyon in the Mt. Dutton area. Tertiary age lag deposits of quartzite cobbles, particularly useful for hammerstones, occur on the slopes of the canyon.

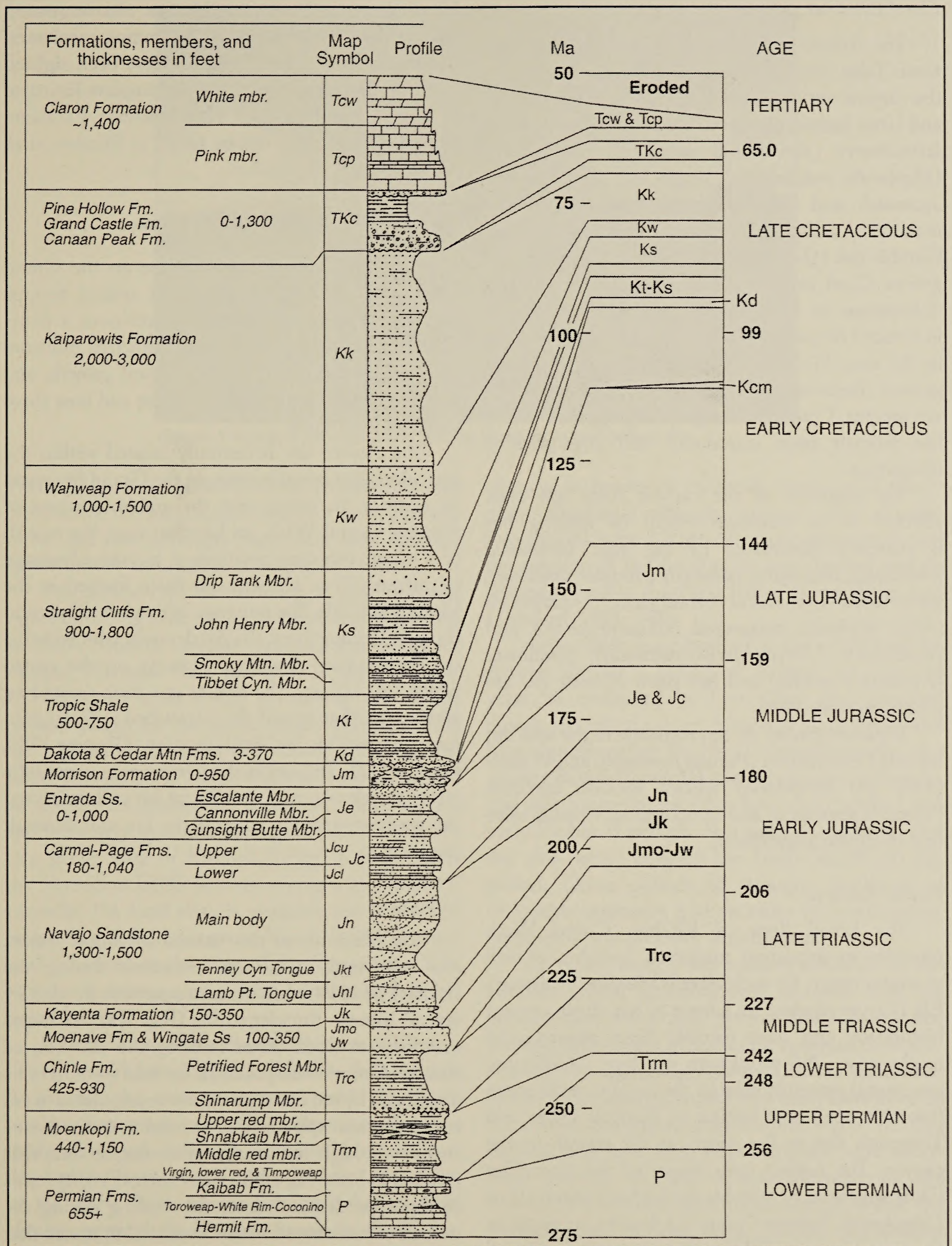


Figure 1.5. Stratigraphic column of bedrock exposed in the Kitchen Corral Drainage (after H.H. Doelling, R.E. Blackett, A.H. Hamblin, J.D. Powell, and G.L. Pollock).

Floral Resources

The Arroyo site lies in the Upper Sonoran life zone. Talus covered slopes and uplands bordering the canyon are dominated by pinyon (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*), with Utah serviceberry (*Amelanchier utahensis*), buffaloberry (*Shepherdia rodundifolia*), single leaf ash (*Fraxinus anomala*) and Mormon tea (*Ephedra viridis*) making up a significant portion of the understory. Gamble oak (*Quercus gambelii*) occurs in occasional groves. Cacti include beavertail (*Opuntia sp.*) and *Echinocereus sp.* Ricegrass (*Stipa hymenoides*) occurs in reduced frequency due to a long history of grazing in the area. Muhly grass (*Muhlenbergia sp.*), grama grasses (*Bouteloua sp.*), and galleta (*Hilaria jamesii*) are present. Crested wheatgrass (*Agropyron cristum*) has recently been introduced and cheatgrass is ubiquitous.

The alluvium of the canyon floor has been affected to an unknown extent by grazing but is currently dominated by big sage (*Artemesia tridentata*), four-wing saltbrush (*Atriplex canescens*), greasewood (*Sarcobatus vermiculatus*), squawbush (*Rhus trilobata*), snakeweed (*Gutierrezia sp.*), and rabbitbrush (*Chrysothamnus nauseosus*). Sunflower (*Helianthus annuus*) and bee plant (*Cleome sp.*) are prolific in some years.

Riparian species are not common in the area but include Cottonwood (*Populus fremontii*) and Willow (*Salix sp.*) Introduced species include tamarisk (*Tamarix pentandra*) and an occasional Russian olive tree (*Eleagnus angustifolia*).

Faunal Resources

The broad floor of Kitchen Corral Wash provides an important migration corridor, as well as winter range, for mule deer (*Odocoileus hemionus*). Elk (*Cervus elaphus*) are known to have been present historically and have recently been reintroduced to the area. No pronghorn antelope (*Antilocapra americana*) presently exist in the canyon or the more favorable open sage habitat in Kimball Valley and Telegraph flat, to the south, at the mouth of the canyon. The rugged talus slopes of the Vermilion Cliffs appear to be suitable for bighorn sheep (*Ovis Canadensis*), however, none are known to occur in the area at present. Rabbits (*Sylvilagus auubonii*) and hares (*Lepus californicus*) are at times prolific. Coyotes (*Canis latrans*), Gray fox (*Urocyon cineroargentus*), and Red fox (*Vulpes vulpes*) are common carnivores. Mountain lions (*Puma concolor*) have been sighted as well as Bobcat (*Lynx rufus*). A complete listing of mammals found on the Grand Staircase-Escalante National Monument can be found in Flinders et al. (2002).

Agricultural Options

Successful agriculture of maize on the Grand Staircase is dependent on several critical factors: appropriate soils with adequate nutrients, a frost-free season of 120 days or more, sufficient moisture received at the critical stages of plant growth, and most important, knowledge of where and how these variables interrelate.

The Arroyo site is centrally located within the agriculturally favorable zone on the Grand Staircase. In addition to being near the arable alluvium of Kitchen Corral Wash, its location near the mouth of a minor tributary positions it to take advantage of outwash from a catchment basin formed in the Vermilion Cliffs. The outwash, which contributed to the post-occupational alluvial deposits which buried the Arroyo site - and then recently cut the arroyo which (re) exposed the site, at one time created an alluvial fan that spread the outwashed sediments to form an ideal "akchin" field situation (Glassow 1980, Hack 1942). The outwashed sediments eventually raised the elevation of the alluvial fan and redirected the wash around the edge of the fan and through the site.

Climate

The efficiency of this natural irrigation system was witnessed on several occasions during the summer of 1994 when excavations were flooded by several intense thunderstorms (Fig. 1.6). A major drawback to flood water farming the alluvium of Kitchen Corral is the potential for field systems to be devastated by too much runoff, or worse, a head-ward entrenchment episode that started a wash down-cutting through the sandy, rather fragile soils that resulted in lowering of the water table. Field systems of this type demanded careful tending during the intense rainstorms of summer and fall to insure that floodwaters were distributed evenly over the fields. Another observation is that when Kitchen Corral

Figure 1.6. Local thunderstorm, facing south from the Arroyo site.

Wash is flooding, possibly from a thundershower miles away, the local arroyo may not flow, and vise versa. The two drainages then offer very different opportunities and risks to the agriculturalist.

Precipitation in the Kitchen Corral drainage varies according to elevation and perhaps topography as well. Modern annual precipitation at Bryce Canyon National Park (8,000'+) is approximately 15" (Ashcroft et al 1992). Frequently one of the coldest places in the state, Bryce National Park has a growing season of only about 100 days. The BLM rain gauge at Nephi Pasture (6,000'), located on the terrace above the Vermilion Cliffs, reports approximately an annual average of 12.5". The BLM rain gauge data in Kimball Valley (5,500') below the Vermilion Cliffs receives averages less than 11" annually. No local data is available for the length of growing season; however, Kanab (4,950'), which is also located at the base of the Vermilion Cliffs, reports an average annual frost – free period of 171 days (Ashcroft et al. 1992).

Successful agriculture in the alluvium of Kitchen Corral would have required a stable field system. At present the wash is downcut with significant headward entrenchment of its tributaries. A recent study of the relationships between sediment load, flood-plain formation, and climatic variability in the Paria River drainage found that regional climate, particularly El Nino-Southern Oscillation (ENSO) conditions, have the biggest effect on flood plain formation. "The close relation between changes in frequency of floods, storms, and flood-plain alluviation strongly suggests that climatic fluctuations have a large effect on aggradation and degradation of the flood plain and channel and on sediment load in the Paria River." (Graf,Webb, and Hereford, 1991: 141).

Agriculture was practiced in the vicinity of the Arroyo site for a period of at least five hundred years, as evidenced by four other sites recorded during the initial survey. Although all of these sites have significant late Pueblo II occupations, two also display Basket Maker III storage cists and pithouses, and one has ceramics from both the Pueblo I and early Pueblo II periods. It is unlikely, however, that the sites were occupied the entire length of that period. Given periods of drought, depletion of renewable resources, and episodes of downcutting, occupation was probably intermittent.

As noted earlier, the options available to the Kitchen Corral agriculturalists included both the akchin flood-water field system and sub-irrigated farming techniques. Alternating episodes of down-cutting and aggrading, due to El Nino conditions or other phenomena, would very likely have affected the success and failure of agriculture. Cyclic weather regimes may have been responsible for both short-term periods of site non-use throughout the Formative period along Kitchen Corral. While the reconciliation of long-term climate fluctuations with local abandonments has been documented (Gummerman, 1988); demonstrating congruence

between a pattern of short-term episodic site use and local arroyo histories is a much more difficult proposition to demonstrate.

AN OVERVIEW OF GRAND STAIRCASE PREHISTORY

This section provides a brief overview of the prehistoric record on the Grand Staircase physiographic section (Stokes 1986) and the surrounding area. It is not meant to be comprehensive but rather it is an attempt to place the Arroyo site in the context of time and provide perspective on the occupation of the area both leading up to the occupation of the Arroyo site, as well as the period succeeding it.

The earliest radiocarbon date on the Grand Staircase is taken from the femur of a Columbian mammoth found in a wash on the Skutumpah Terrace (McFadden 2000). During the late Pleistocene, Paleoindian hunters of the Clovis culture, sought and killed mammoths and a variety of other megafauna including horse, camel, and bison. Clovis sites in the Southwest are now thought to date as early as 13,500 calendar years ago (Polyak et al. 2004). The Skutumpah mammoth yielded a radiocarbon date of 11,455 B.C. (Beta-135017,calibrated intercept age) allowing for the possibility that it represented a kill site. Unfortunately, the excavation revealed no associations with man. Mammoth remains on the Colorado Plateau, some in nearby Glen Canyon, are dated as recently as 11,270 B.P, but they too lack cultural associations (Agenbroad and Meade, 1989). It is possible that the Clovis big-game hunting tradition was not practiced on the Colorado Plateau, although the issue is far from resolved.

The earliest radiocarbon dates associated with cultural deposits in the Monument region are about 10,000 years old and come from a Paleoarchaic/ Early Archaic sheltered site in the Escalante River drainage (Janetski et al. 2012). The deeply buried Paleoarchaic deposits at North Creek Shelter yielded no evidence of extinct megafauna, but did yield stemmed points and a variety of modern faunal remains including elk or deer. Charred seeds in the early deposits and grinding tools in the Archaic levels suggested to the researchers some degree of plant use throughout both periods (Janetski et al. 2012).

Paleoindian projectile points and actual camp sites, although rare, are reported from southwest Utah (Copeland and Fike 1988; Schroedl 1991). Ryan and Keller (1987) report on a resharpened Paleoindian spear point found in isolation on the Skutumpah Terrence. Early spear point fragments known as Western Stemmed Tradition, made from obsidian sourced to the Mineral Mountains of the Great Basin, have been found on the Grand Staircase. The age of these points has been estimated to be 7,500-6,500 B.C. (Carter et al. 2004). It may be, however, that their occurrence is the result of being collected elsewhere and introduced to the Grand Staircase much later through trade or perhaps wide ranging Paiute bands.

Much better represented on the Grand Staircase is the period following the Paleoindian Period known as the Archaic. The lengthy Archaic Period is divided into Early (6.000 B.C.- 4,000 B.C.), Middle (4,000 B.C.- 2,000 B.C.), and Late (2,000 B.C. – 100B.C.) sub-periods. These periods are recognized by a range of temporally sensitive projectile point types found in the area (Keller 1987; Hauck 1979; Kearns 1982; Geib, Collette, and Spurr 2001).

In central Kane County, the lower levels of the Broken Arrow Site, a large, east-facing rockshelter, have been radiocarbon dated as early as 6,000 B.C. (Talbot and Janetski 1999). The occupants of this base camp relied heavily on collecting sand dropseed, (*Sporobolus* sp.), a unbiquitous and productive grass that ripens during the spring. Other native seeds found at the site included amaranth, goosefoot, and rice grass. On the surrounding benches, scattered camps displaying hearths and milling stones appear to represent small groups foraging for these plants (Collette and Spurr 2001).

Hunting was an equally important activity throughout the Archaic Period. Inventory data from open camps and small activity areas on the Grand Staircase (Keller 1987; Christenson 1983) and the Kaiparowits Plateau (Kerns 1982; Gieb, Collette, and Spurr 2001) indicate that both hunting and gathering occurred over vast tracts of land.

A few sites in the region, including the lower level of the Arroyo site (see Chapter 5), have yielded late Archaic dates just prior to the advent of agriculture north of the Colorado River. These sites offer evidence that a hunting and gathering population was in place in the region that could

have been introduced to maize agriculture, either by migrants moving into the area, or perhaps by acquiring the concept and seed through trade with nearby groups.

The initial farmers on the Grand Staircase are known as the Basket Makers (Fig. 1.7). Distinctive basketry and perishable artifacts characterize this period which is termed Basket Maker II. Ceramics were not used until Basket Maker III times The earliest tree-ring date on the Grand Staircase is associated with a storage cist dated 81 B.C. (McFadden 2000a). By the 2nd century A.D. sizeable pithouse villages were being built in the area (Walling-Frank 1998). The local Basket Maker II culture has strong similarities with that of the Four Corners region, but also retains a distinctiveness of style that argues for local development that was possibly centered on the Grand Staircase.

A local sequence of development, well represented on the Grand Staircase, but also evident in the surrounding areas suitable for agriculture, grew out of the earliest Basket Maker period. The puebloan sequence demonstrates a lengthy, continuous occupation of the area by a strongly agriculturally oriented population known as the Virgin Anasazi. A degree of isolation from other Anasazi groups seems to have encouraged locally distinctive styles of architecture, rock art, ceramic design, and projectile point forms. Perhaps as important is the effect that the local environment had on the occupants of the Grand Staircase. Data from the combined investigations of inventory and excavation suggest that the agriculturally marginal (highly variable at any rate) environment of the area had a pronounced effect on the behavior of the Virgin Anasazi. Site distribution patterns, known from intensive inventories, suggest that a variety of arable micro-environments were farmed. Unlike many areas in the southwest, which were used for relatively short periods, excavation data supports the observation that community-sized site clusters on the Grand Staircase were occupied, off and on, over long periods of time.

During the Late Pueblo II period (A.D.1070-1150) new forms of architecture, ceramic design, projectile points, and other objects of material culture were introduced into the Virgin culture area (McFadden 2002). The Arroyo site displays an intriguing mix of these Kayenta and Virgin material

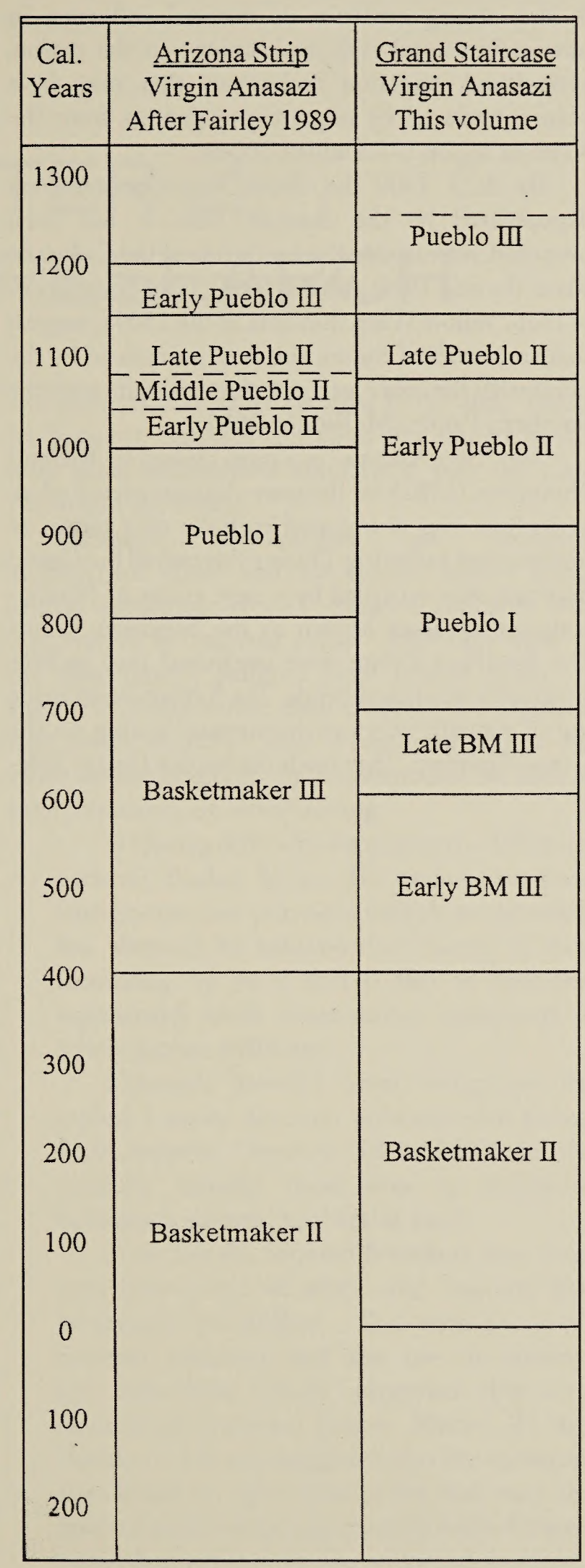


Figure 1.7. Formative Temporal periods

culture traits. On the eastern Arizona Strip, there is also strong evidence of external influence in new architectural style and, unique in the region, agricultural irrigation techniques that may have been introduced by migrant populations from the Kayenta region (McFadden 2004).

By A.D. 1300 the Grand Staircase area was depopulated by the Anasazi who, it has been proposed, retreated to the south side of the Colorado River (Lyneis 1996; Aikens 1967). Rare occurrences of Hopi Yellow Ware, that date to the 1300's, suggest that some sort of connection was maintained by the Hopi with the area – perhaps through trade with the Southern Paiute (McFadden 2003).

The "Neo Archaic" is a term coined by Richard Thompson (1982) for the post-Anasazi period when agriculture was abandoned in favor of a return to hunting and gathering. During this period the Grand Staircase was occupied by a new group of Numic-language speakers known as the Southern Paiute. The Southern Paiute were organized into mobile, geographically based bands. The Kaibab Band made use of virtually every environmental setting on the Grand Staircase. They made distinctive Desert Side-notched arrow points, fine basketry, and a utilitarian type of pottery known as brown ware. The earliest dated Southern Paiute site on the Grand Staircase is a camp east of the city of Kanab that yielded a series of radiocarbon dates ranging from perhaps as early as A.D.1300 through modern times (Firor 1994).

The prehistoric Southern Paiute are perhaps the widest ranging groups identified in the region. Evidence in the form of projectile points and brown ware ceramics are found in virtually every environmental zone, from the high plateaus, to the low deserts. The Kitchen Corral area is ethnographically known to have been used by members of the Kaibab Paiute band (Kelly 1964). Recent inventory at Bryce National Park on the Paunsaugunt Plateau, in the head waters of the Kitchen Corral drainage, has identified Anasazi ceramics from the Eastern Grand Staircase probably introduced by the Southern Paiute (Wenker 2004). Various Paiute bands maintained their extensive use and occupation of the region until about 1860 when the effects of European migration drastically reduced their range.

Chapter 2
Previous Research

This section focuses on the history of archaeological research in the Kitchen Corral Wash drainage over the past 70 years. It describes the early recognition of a Basket Maker – Anasazi sequence by Julian Steward, reports recent radiocarbon and tree-ring dating of the sequence, and significantly, identifies the sequence as Virgin Anasazi - a distinctive cultural manifestation that extends west to the St. George Basin and beyond to the lower Virgin River and Moapa Valley.

EARLY RESEARCH

Julian Steward, while at the University of Utah, conducted the first archaeological investigations on the eastern portion of the Grand Staircase during the summer of 1932. Traveling with pack outfit and local guide, Steward set out to "explore areas that were blanks on the archaeological map" (Steward 1941). Of the 142 sites that he documented between Johnson Canyon and the Paria River, 47 were in the Kitchen Corral drainage (Fig. 2.1).

Steward's stated research objective was to discover the source of cultural influence for the Northern Periphery of the Southwest (what would later become known as the Fremont culture). That goal was not realized, but he did contribute substantially to understanding the culture history of the area by describing a sequence of architectural types and site layouts that roughly corresponded with the better known Basket Maker III - Pueblo II sequence in the San Juan drainage. Steward also described in detail the material culture associated with each period including ceramics, chipped and ground stone tools, and even rock art that he believed represented each of the periods. He also noted that the petroglyphs and pictographs seemed peculiar to the area. While his basis for comparative studies was limited, he did note some architectural similarities with the Zion National Park region.

Steward's observations on changing architectural styles and site layouts helped frame several settlement-related research concerns that continue to be relevant today. Although most of his observations suffered from relying solely on surface evidence rather than excavation, a situation that wasn't rectified until recently, several of his more salient observations, accompanied by current interpretations, are worth noting.

1) Having difficulty discerning the difference between Basket Maker III period slab-lined storage cists and pithouses (which are generally less obvious), he believed that clusters of cists, measuring up to 7 and 8 feet in diameter, represented small communities composed of family groups or lineages.

Although Steward never recognized the typical 5 meter diameter pithouse with formal floor features (Steward 1941; 289), he did correctly identify these sites as residential farmsteads situated near arable land.

2) At Site #2, Steward described three large cists constructed of adobe and masonry that he termed "pit lodges". Two were excavated. Steward reasoned that the use of masonry and slab "base boards" suggested they were transitional between Basket Maker III and Pueblo II. He also suggested that the numerous cists found on open sites in the area may also have once had encircling masonry walls. Steward noted that, while there was no formal fireplace, a fire had been made on the floor suggesting that the structure had served as a domicile.

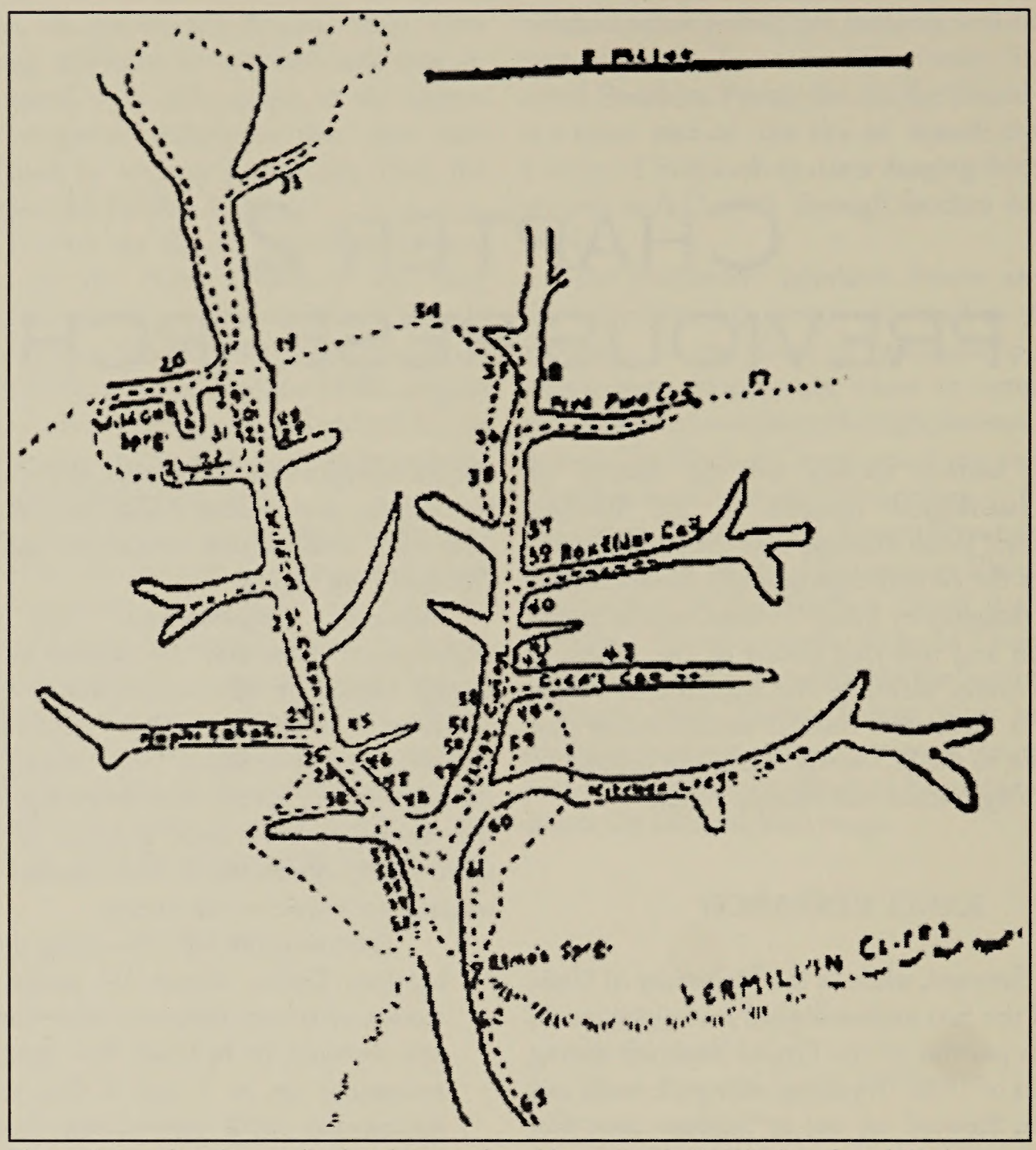


Figure 2.1. Julian Steward's sketch map of puebloan sites in the Kitchen Corral Wash drainage recorded in 1932 (Steward 1941).

Site #2, presently recorded as 42Ka1811 (Fig. 2.3), was stabilized in 1999 (Fiero 2000). Three recently obtained radiocarbon dates suggest the site was occupied, probably intermittently, between A.D.800 and A.D.1000. This information compares well with a recently obtained date (McFadden 2000a) from Judd's Cave 1 in Cottonwood Canyon which held a nearly identical structure that had a formal hearth (Judd 1926). Judd did not report whether the hearth was constructed as an integral part of the structure or if it was a later modification.

Ephemeral occupation and episodic use of sites in the Virgin area, as reflected in the presence of storage facilities and a lack of formal residential structures (or the use of storage cists for temporary occupation), may represent a greater degree of mobility during Pueblo I and Early Pueblo II times.

3) Steward, noting the presence of Basket Maker slab-lined cists on Pueblo II period sites, considered the cists to be "survivals" of the earlier period (Steward 1941:288). Although this view has persisted, excavation data demonstrates that most such sites displaying this kind of architectural variability have simply been re-occupied. This tendency for re-occupation has been described as part of the "Virgin pattern"and may reflect an adaptive strategy of

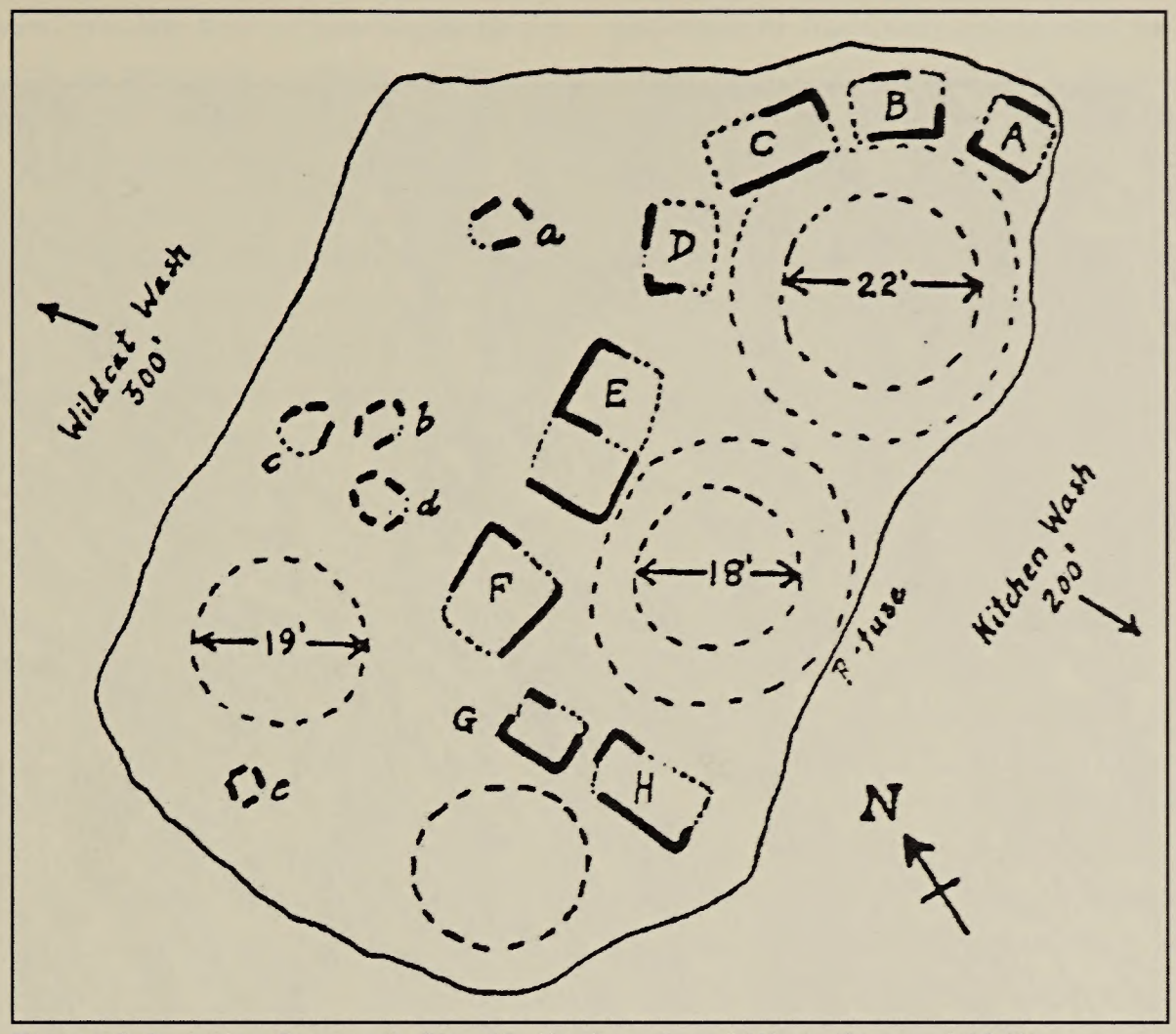


Figure 2.2. Julian Steward's Site 48, Kitchen Corral Wash (Steward 1941).

periodic shifting between a series of farmsteads (McFadden 1996).

4) Steward viewed the Pueblo II influences, apparent at his "masonry house" sites, as emanating from the Kayenta district (Steward 1941:293). He did, however, believe that the local Basket Maker population adopted those traits over a period of time citing the perpetuation of slab-lining, in otherwise late masonry rooms, as evidence for gradual change.

More recently, Aikens (1967) described the "Pueblo II expansion" in the Virgin culture area as in situ growth rather than population movement. In fact, there is evidence that supports both models in the Kitchen Corral drainage and specifically at the Arroyo site. The interpretation, presented in Chapter 12, is a sort of hybrid model: there is no question that a sizable and well-adapted population existed on the Grand Staircase prior to the introduction of Late Pueblo II Kayenta material culture; however, the abruptness of the Kayenta influence argues for change via population movement rather than the diffusion of architectural styles, projectile point types, and ceramic designs.

5) The occurrence of fully subterranean pit structures on Pueblo II Virgin Anasazi sites is not uncommon. Their interpretation as kivas, however, remains problematic (see Chapter12). The kiva was a hallmark of Kayenta Pueblo II influence that had important ideological/social implications that have been recognized by virtually every investigator in the region (Judd 1926; Wetherill and Smith 1934; Schroeder 1955; Aikens 1967), this was true for Steward as well.

Steward described the typical Pueblo II residential site layout in Kitchen Canyon as a series of masonry rooms surrounding a depression (Fig. 2.2). He believed that the masonry rooms were too large to have functioned as storage rooms and that they represented family residences. He argued that if the depression didn't function as a pithouse it "undoubtedly contain(ed) a kiva" (Steward 1941:294). From this interpretation of site layout, he reasoned that "Each of these conventional house groups must have held a definite social unit, which, judging by its size, could not have exceeded a family or lineage of 20 or 30 people" (Steward 1941:294).

Figure 2.3. Selected sites in the Kitchen Corral area, eastern Grand Staircase.

Julian Steward was the first archaeologist in the Virgin culture area to seriously consider settlement patterns as a means of interpreting the past. He described the typical residential site layouts for both the Basket Maker and Pueblo II periods based on surface evidence. From those patterns he made observations on community structure and population density. Although modern interpretations of site layouts, based on excavation data, differ considerably from Steward's view, his pioneering efforts at settlement pattern analysis provided a baseline for future work.

RECENT RESEARCH

In an effort to gather comparative data for understanding the cultures then being studied in Glen Canyon as a part of the Upper Colorado River Basin Archeological Salvage Project, the University of Utah undertook investigations at several locations in southwestern Utah. On the Grand Staircase, C. Melvin Aikens focused his research in Johnson Canyon 15 miles west of Kitchen Corral Wash. During the 1962 season he undertook both survey and two excavations in the area (Aikens 1965). From this field work emerged his study entitled "Virgin – Kayenta Cultural Relationships" (Aikens 1967). Although the study is now dated, Virgin and Kayenta "ethnicity" remains a viable research topic (Euler 1994; Gieb et al 2001).This is particularly so in the Kitchen Corral Wash locality where material culture traits, particularly architecture, representing both cultures occurs during the late Pueblo II period.

The Gnatmare Site Excavations (42Ka1978)

The Gnatmare Site was excavated by the University of Utah as part of a mitigation project for a Utah Power and Light 500 KV transmission line (Metcalfe 1981). It is a late Pueblo II residential site located along Cottonwood Creek, 10 miles east of Kitchen Corral Wash. The site lies on the extreme eastern margin of the Grand Staircase section (Fig. 2.3). The Gnatmare Site consisted of large, square surface room with a clay-coped hearth. No storage features were identified on site. A fully subterranean pit structure occurred 6 meters to the south. The pitstructure had been abandoned and rebuilt. Site layout and architectural style do not appear to be a continuation of Virgin traditions. Bull Creek projectile points dominated the point collection suggesting a Kayenta cultural affiliation, although the ceramic assemblage included both Virgin and Shinarump types.

This is a rather anomalous site in terms of its environmental setting, isolation from other residential sites, and architecture. On the basis of material culture "trait mixing" Metcalf asserted that, "the Virgin – Kayenta distinction (should) be reanalyzed by those scholars closely involved with the archeology of southern Utah and northern Arizona" (Metcalf 1981: 84).

Metcalf's assessment relied on an essentially synchronic view of Virgin – Kayenta interaction during Pueblo II times. What his review lacked was the perspective subsequently gained from an understanding of the local culture historical sequence. Recent excavations demonstrate a Virgin Anasazi sequence on the eastern Grand Staircase from at least Basket Maker III times. Until about A.D.1050, or the beginning of Late Pueblo II, architecture, ceramics, rock art, and projectile point styles all indicate a close relationship with the Virgin peoples to the west as far as the St. George Basin. After A.D.1050, during late Pueblo II times, a constellation of Kayenta traits suddenly appears in the region. This was probably the result of a complicated process of actual Kayenta migration on the east end of the Grand Staircase but one of diffusion of styles and trade further west in the St. George Basin and beyond to the lowlands of the Moapa Valley.

Energy Fuels Nuclear Vermilion Cliffs Project

Investigations carried out by Abajo Archaeology for the Energy Fuels Nuclear Vermilion Cliffs Project (Westfall 1985) provided excellent temporal and distributional data within the Kitchen Corral drainage (Fig. 2.3). Twenty-six prehistoric sites were recorded including limited activity sites, short term camps, base camps, and habitation/storage sites ranging from Basket Maker III through late Pueblo II. A single late date of A.D. 1310+/- 60 from an isolated hearth lacking diagnostics suggested

the possibility of an early Paiute presence. Test excavations at 5 prehistoric sites provided data on site function, age and cultural affiliation: 42Ka2583, 2584, 2594, 2600 and 2605 (Fig. 2.3). Ceramic analysis identified predominately Virgin types and especially various types in the Shinarump Series including a possible new type: Shinarump Red Ware. Wilson noted that "very little exchange with distant groups seems to be represented (Wilson 1985:125).

A review of the Energy Fuels Project, and reconnaissance level inventory data gathered since, suggest that residential sites in the Kitchen Corral drainage are not solely focused on the main watercourse; rather, they associate with a variety of minor tributaries and agricultural opportunities at some distance from the main wash.

California State University, Long Beach, Archaeological Field School

The primary focus of the CSULB field school for several field seasons was 42Ka1568, a large, architecturally complex Late PII pueblo with underlying earlier components. The site is located at the confluence of Deer Springs Wash and Park Wash, which converge to form Kitchen Corral Wash (Fig.2.3). Actual excavation at the site was limited to clearing two rooms, limited trenching, and a remote sensing program. The effort resulted in three master's degree theses (Morley1993, Valdes1993, Dohr1994) and a professional paper that investigated clay sources for the ceramic assemblage using neutron activation analysis (Neff, Larson and Glascock 1997). The assemblage was found to be "remarkably diverse", indicating to the authors that the vessels (as opposed to the clay sources) originated from a number of different sources.

Radiocarbon dates with intercept dates in the 13th century, collected from the excavations, suggested a Pueblo III occupation to the authors as did Larson's identification of the late Pueblo III Black-on-white ceramic types Betatakin, Kayenta, Tusayan, and Wupatki. A review of the sherds used in the study, however, suggests that the Pueblo III identifications are problematic and should receive additional study.

In fact, although an increasing number of Pueblo III period radiocarbon dates in the Virgin culture area have accumulated, no late Pueblo III ceramic assemblages have been identified north of the Colorado River. This observation is a particularly relevant with respect to the nature of Virgin – Kayenta relationships after A.D. 1150.

Kitchen Corral Wash Burials, (42Ka2664)

Investigations at 42Ka2664 involved the excavation of two burials eroding from the bank of Kitchen Corral Wash (Fig. 2.3). The excavations resulted in the recovery of 6 Late Pueblo II vessels. Macrofossil analysis of the associated deposits yielded *Zea mays* and large quantities of *Chenopodium* spp. Virtually none of the associated site remains intact. A single radiocarbon date of 1080+/-140 B.P. was collected from the site (McFadden 2000a).

Park Wash Site Excavations (42Ka4280)

The Park Wash Site (Fig. 2.3) was a data recovery effort of architectural features exposed in the road bed along deeply incised Park Wash (Ahlstrom 2000). Two partially superimposed pithouses were excavated. Both had benches and subfloor pits typical of early Virgin Anasazi structures. A single tree-ring date, as well as radiocarbon assays, dated both structures to the Pueblo I period. Scattered, slab-lined, circular storage cists, unexcavated but visible from the surface, suggest an earlier Basket Maker III component that remains to be explored. The ceramic assemblage consisted of local gray and white wares. The gray ware was suggestive of early versions of the local Shinarump type found at the Arroyo site (Perry in Alstrom 2000).

The Road Kill Site Excavations (42Ka4859)

The Road Kill Site excavations were conducted in 2001/ 2002 as an in-house BLM data recovery project (McFadden, in preparation). The site is located just north of the Park Wash Site (Fig. 2.3). Road Kill consists of a linear alignment of slab-lined storage cists extending across the county road. The cists varied in shape from oval to square and were slab lined with coursed masonry upper walls. In two instances flagstone pavements connected the cists forming a sort of proto-room block. Abutting each of the three cists on the south was a jacal habitation room with hearth and floor pits.

Radiocarbon dates placed the Road Kill Site in the late Basket Maker III to early Pueblo I range – about the same time period as the Park Wash Site. Similar roomblock layouts occur in sites from this period to the east at the Dead Raven Site (Walling and Thompson 2004), at the Red Cliffs Site (Dalley and McFadden 1985) and the Little Man cluster in the St George Basin (Dalley and McFadden 1988). In addition to the lightly constructed surface rooms however, the above sites had pithouses located to the southeast of the room block. No evidence for pithouses was identified at the Road Kill Site due to the limited data recovery goals of the excavations. A remote sensing project has been proposed to explore for pithouses in the deep alluvial deposits south of the room block.

Steward's Site 18 (42Ka5571)

This site is a small rock shelter with an adjacent granary recorded by Julian Steward in 1934 (Steward 1941). Presently designated 42Ka5571 (Fig. 2.3), the site recently yielded a tree-ring date of A.D. 1150+r. The pinyon pine tree-ring specimen, one of the few collected on the Grand Staircase, was obtained from a timber incorporated into a masonry wall. Apparently the timber had previously been cut by Steward in an unsuccessful attempt to date the site. A Cave Valley style pictograph in the shelter suggests an earlier occupation or possibly the persistence of the Virgin style rock art into late Pueblo II times.

One Wall Shelter (42Ka4860)

Although Steward (1941) did not mention the presence of the Road Kill site, he did record and photograph a series of small masonry storage units located in the cliffs above it. A twig from the adobe matrix of One Wall Shelter (Fig. 2.3) produced a Pueblo I era date of 1200+/-40 BP (McFadden 2000a). The presence of this series of individual granaries and what appears to be short-term use of the shelters for residential purposes, suggest that the use and occupation of this area during the Pueblo I period may have been intermittent.

42Ka5628

42Ka5628 is a non-architectural rock shelter with a Cave Valley style pictograph (Fig. 2.3). A corn cob from the surface of the site dated 960+/-70 BP .The occurrence of this rock art style is consistent with a pre- Late Pueblo II Virgin Anasazi occupation in the Kitchen Corral drainage. A second date of 450+/-B.P. suggests a later Southern Paiute use of the shelter.

Alluvial Studies in Kitchen Corral

Richard Hereford's alluvial stratigraphic studies on the Grand Staircase offer important ancillary evidence for understanding the complex relationships between climate and prehistoric use of the land along Kitchen Corral Wash (Hereford 1986, 2002). Past efforts at correlating human use and environmental history have been minimal, but future multidisciplinary studies employing analysis of paleosols, surficial geology, alluvial stratigraphic studies, palynology, and tree-ring chronologies have been proposed to interpret past environments of the Kitchen Corral drainage (Hereford and Webb 2000).

A spin-off of the California State University Long Beach field school was a study of alluvial deposits in Kitchen Corral Wash (Kulp 1995). This thesis was overseen by Dr. K. Rigsby, initially associated with the C.S.U.L.B. field school, and subsequently with East Carolina University. Kulp provided a series of radiocarbon dates from strata that roughly correlated with Anasazi and Basket Maker horizons exposed in the banks of Park, Deer Spring, and Kitchen Corral Washes. Kulp proposed that Anasazi abandonment of the area "was the result of high variability of yearly to decadal rainfall occurring in conjunction with times of high population pressure and intensive land use" (Kulp 1995:96).

BLM Inventory

BLM-generated intensive inventory data from nearby Seaman Wash and Finn Little Wash, the two major drainages to the east of Kitchen Corral, contributed substantial distributional data towards the understanding of local settlement patterns (McFadden 1996). Data from these inventories provide context for understanding the nearby occupation along Kitchen Corral Wash. These inventories demonstrated: 1) a sequence of occupation from Basket Maker III (or earlier)

times through late Pueblo II, 2) cultural affiliation with the Virgin Anasazi based on architectural types and ceramic style, 3) clustering of residential sites into dispersed communities on, and adjacent to, arable land and, 4) the tendency for a large percentage of sites to be multi-component. These observations, considered as a related group of traits, have been termed the "Virgin Pattern." It has been hypothesized that this pattern of behavior reflects a specialized adaptation to the Grand Staircase that involved shifting between multiple agricultural locales in response to climate change (McFadden 1996).

RESEARCH ORIENTATION

Excavation of an archeological site is, by its very nature, a destructive process. Features and their contexts are destroyed as they are revealed. It is therefore essential to maximize the data retrieved from the non-renewable record of the past that a site represents. Research designs identify the potential contributions a site can make, usually in the form of questions or hypotheses, to our understanding of the past. The most relevant questions are framed in the context of previous research. A critical consideration is the potential for a site to yield data that addresses those questions – obviously not all sites are appropriate vehicles for answering specific questions.

The research design may also describe the field and lab methods to be employed that guide the excavation and analysis phases. The use of appropriate methods, and the eventual reporting of the excavation results, insures the continuity of future research and the ability to pursue and build upon the results of the investigation.

A formal research design outlining excavation procedures, research orientation specific research objectives and was submitted to and accepted by the Utah State Historic Preservation Office in 1994. It is reproduced in its entirety below.

ARCHAEOLOGICAL RESEARCH DESIGN FOR DATA RETRIEVAL AT THE ARROYO SITE – 42KA3976

Project Background

Site 42Ka3976, the Arroyo site, was recorded in the fall of 1993 during a routine clearance inventory of a prescribed burn and reseed project. The project is located in central Kane County along the western edge of the Kitchen Corral Wash drainage. One of the six Late Pueblo II sites recorded, the Arroyo site is unique in that it was completely buried by alluvium. A recently developed arroyo has cut through the approximate center of the site exposing a probable kiva, at least two shallower pit structures, occupational surfaces, small pit features, a burial, a portion of the masonry room block and a 40 meter long profile of well-defined midden. In short, all of the expected features on a late Pueblo II site have been rather neatly sectioned. Ceramics are abundant and occur in all of the features as well as the midden. Both the midden and features display large quantities of datable charcoal. Subsistence data i.e. bone, and probably floral botanical remains, are abundant and in excellent condition. Ceramics from all features appear consistent with a late PII temporal assignment ca. A.D. 1100. A radiocarbon assay of A.D. 1090 +/- 50 taken on twigs from the room block confirms this assignment. Several deep ash strata could indicate an earlier occupation.

During September 1993, a crew of volunteers from the Dixie Chapter of the Utah Statewide Archaeological Society (USAS) and the Arizona Strip District assisted Cedar City District archaeologists in cleaning the arroyo walls, drawing profiles of the features and collecting artifact samples. This documentation effort resulted in the salvage of a great deal of data at very little expense – it also demonstrated that a great deal of potential data remains in an exposed and threatened situation.

This proposal for additional data recovery is an expansion on the "emergency" effort of 1993. Having weathered the late rains of 1993 with only minor damage, it is proposed that the identified features remaining in the arroyo walls of 42Ka3976 be excavated. There is no question that these features will be lost either to erosion or looters if they are not excavated promptly. This type of approach, in lieu of large scale projects and in combination with intensive inventory, has become a mainstay of data collection in the Cedar City District and particularly in the Kanab area. It is cost effective both from the

standpoint of actual expense as well as preservation of the resource. A volume of previous similar projects intended for publication in the Utah BLM Cultural Resource Series is in preparation.

Previous Research and Orientation

Apart from the credible but early efforts of Neil Judd (1926), Jesse Nusbaum (1922), Wetherill and Smith (1934), and Julian Steward (1941), modern research on the Grand Staircase (Stokes, 1986) portion of the Virgin Anasazi culture area began in the 1960's as an outgrowth of the Glen Canyon project. C. Melvin Aikens (1965) conducted excavations at two site is Johnson Canyon – Bonanza Dune and the Sandhills site. This field work, combined with additional excavations on the Kaiparowits Plateau to the east and the St. George Basin to the west, resulted in a synthesis entitled *VIRGIN-KAYENTA CULTURAL RELATIONSHIPS* (1966). Citing the distribution of C-shaped and linear or L-shaped pueblo architecture as the basis for distinguishing between the two culture areas, this volume still stands as the standard reference for the Virgin culture area.

Acknowledging the limited excavation and testing efforts carried out under the aupices of the BLM (Parts and Pieces; in preparation); several sites at the Energy Fuels Mill Site in Kitchen Corral (Westfall, 1985) and UDOT salvage efforts at the Hog Canyon site (Schleisman and Nielson, 1988), two small but noteworthy excavations have been undertaken since Aikens conducted his fieldwork. In 1980 and early Pueblo II farmstead called the Kanab Site (42Ka1969) was excavated by Nickens and Kvamme (1981) and reported in Utah BLM's Cultural Resource Series. This site with its pithouse residency, simple storage architecture and very limited gray ware ceramic assemblage, stands as the area's early Pueblo II "type site". It was occupied until sometime in the late 11th century.

Later in the summer of 1980, the University of Utah excavated the Gnatmare Site (Metcalf, 1981), a slightly later site of similar size and function located on the eastern margin of the Virgin culture area. In considerable contrast to the Kanab Site, the Gnatmare Site displayed a large masonry residential structure and an apparent kiva. In addition, the ceramic assemblage on Gnatmare was much more varied with corrugated (rather than plain gray) accounting for 93% of the gray ware collection. The introduction of Bull Creek projectile points, red wares, orange ware ceramics and new white ware styles documented a sudden and thorough change in material culture.

Lacking data to deal with the nature of temporal change between early PII and late PII manifestations, Metcalf focused on the basis traditionally used for defining the "ethic boundary" between the Virgin and the Kayenta culture areas, i.e. ceramics and architecture. He found these criteria confusing – the ceramic criteria were contradictory and the architectural self-fulfilling. Questioning the usefulness as well as the validity of defining a culture on these grounds, he suggested that the distinction between the Virgin and the Kayenta be dropped altogether (1981). The relationship between the Virgin and the Kayenta culture areas remains vague and ill-defined.

The Arroyo site dates to the same period as Gnatmare and has a number of material culture similarities, i.e. late ceramics and a deep kiva-like pit structure. Nearby, another late PII site (42Ka3328) was tested in 1990 as part of the Seaman Wash Inventory investigations (McFadden, 2000a). It displayed the Virgin characteristic of accretional room block development. Assuming that such complex internal site developmental patterns reflected mobility, this work raised the question of whether long-term but intermittent site occupations were part of an adaptive "process" in the uplands.

A recent analysis of settlement patterns, based on intensive in-house inventories, correlates Virgin site distribution with a variety of micro-environments on the Grand Staircase. Based on this data a specific adaptive strategy involving periodic mobility in response to a variety of environmental stimuli has been proposed for the Virgin Anasazi of the Grand Staircase (McFadden, 1993). In large measure, this hypothesis accounts for the material culture distinctiveness of the Virgin Anasazi – the Virgin Tradition then is seen as an adaptation rather than simply a constellation of material culture traits.

Metcalf did have a point, he simply lacked the contextual data to determine whether Gnatmare represented the latest manifestation in the long continuum of Virgin occupation, or, if the site was occupied by an intrusive Kayentan population (as

suggested by the quick shift in material culture and the site's peripheral geographic location). A third and quite viable possibility, not previously considered, involves a diachronic perspective that allows for a shifting ethic boundary on the eastern edge of the Virgin culture area. Such an overlapping of Virgin and Kayenta settlements during late PII could be either concurrent or sequential.

A fourth possibility that is occasionally entertained is the notion of a "mixed" culture. This notion was given some support by Colton who noted that ceramics only gradually change from one area to the next. While gradations of change may occur in material culture, the validity of a Virgin-Kayenta hybrid is questionable because adaptive strategies do not interbreed. The appearance of a "mixed" culture on the Grand Staircase is most likely the result of two separate occupations.

Specific Research Objectives/Methods

The primary objective and orientation of the cultural resource program in the Kanab Resource Area is the identification of settlement patterns in their various temporal and ecological contexts. This research design will focus on specific issues that relate to the on-going analysis of Virgin settlement patterns on the Grand Staircase. These issues can be subsumed under the following domains:

Subsistence

This issue remains central to the understanding of any settlement pattern. The degree of reliance on domestic vs. wild foodstuffs remains controversial (Allison, 1990). Collection of macro faunal and floral material and pollen samples will contribute to the process of characterizing late PII subsistence on the east end of the culture area.

Faunal analysis of unmodified bone will be conducted in order to address game procurement strategies. This is an issue we relate to settlement patterning. A lack of Anasazi hunting camps on the Grand Staircase suggests that game was procured locally – perhaps in adjacent fields. Presence of less-useful bone may be an indication of the distance from the site it was taken.

The fill of all structures and features will be screened with quarter-inch wire mesh (and 1/8" where appropriate). Flotation samples will be collected in columns from profiles and from all floor/occupational surfaces. At this time a UCLA PhD. candidate, Mr. Steven Martin, has requested to conduct an analysis of subsistence data using the facilities of Paleoethnobotany Laboratory at the Institute of Archaeology. We will look favorably upon incorporating his research proposal into our design.

Ethnicity

Ethnicity, as defined by the archaeological material traits, remains an open question. Precise dating of the Kayenta influence onto the Grand Staircase during the late PII period would help to explicate the nature of the so-called PII expansion – particularly in regard to environmental change on the Colorado Plateau (Gumerman, 1988) and occupation of other nearby uplands (i.e. Fiftymile Mt. and the Paria Plateau).

Our concern in the Kitchen Corral vicinity would be whether this "expansion" represents a diffusion of traits, or actual migration of large populations. The sudden appearance of a new settlement/subsistence pattern on the Grand Staircase would suggest an intrusive population; on the other hand, a long-term or intermittent occupation of the Arroyo site (or similar types) would argue for a persistence of the Virgin pattern with only a veneer of Kayenta traits.

Site Spatial Structure

Site spatial organization and/or layout characteristics reflect population size, social organization and developmental history. The limited excavation transect available will be potentially enhanced by inviting Dr. Elizabeth Ambos of CSU-Long Beach's Dept. of Geological Sciences to participate in the project using their remote sensing equipment.

Site developmental history, as reflected in the occupational sequence of the pit structures and stratigraphy, addresses the question of adaptive strategy continuity and hence, in our model, comments on ethnic affiliation.

Documentation of a possible kiva (or two) will add to the very limited data regarding this type of feature. Because kiva architecture relates to the social/ceremonial aspects of culture, it is a more direct measure of cultural affiliation than most

architectural structures.

The presence of at least three pit structures on a late PII site is surprising considering that Kayenta site layouts often appear formal, standardized and short lived. Recent work at Southgate in the St. George Basin has revealed a large number (and great variety) of pithouses seemingly extramural to the formal site layout.

No such features have been recorded on the Grand Staircase. If the extramural pit structures at the Arroyo site are sequentially occupied they suggest a "Virgin pattern" of settlement (reflection a mobile adaptive strategy) or, if contemporaneous, simply a previously unobserved population aggregate. Either way, documentation of these structures will contribute data on late PII site layouts.

Ceramic Issues

Late PII ceramics in the eastern end of the Virgin culture area remain problematic. Determining local vs. exotic red ware and white ware types relates directly to cultural affiliation. So too does the temporal and geographical distribution of Shinarump Brown ware. This type, considered indigenous to the Virgin area, has recently been described as a Kayenta type (Euler, 1993).

Apart from demonstrating the obvious external Virgin – Kayenta and possibly Fremont relationships, ceramics should demonstrate to what degree the site has affinities with other ceramically defined Virgin groups i.e. Shivwits Plateau, Mt. Trumbull etc..

With the possible exception of formal tools, chipped and ground stone debris will probably be, numerically, a very minor artifact category. Both relate directly to the issue of subsistence. Beyond standard description our interest in chipped stone will focus on the logistics of game procurement.

Burial

An apparent burial was recorded in the north wall of the arroyo. The pit outline is distinguishable and seems to originate in or just below the midden deposit. At present, a small portion of the skull is exposed. While excavation of the burial is not central to this proposal, skeletal remains none-the-less have the potential to yield a variety of cultural data regarding mortuary practices, subsistence, nutrition, and pathological aspects of the local Anasazi population. An in-depth analysis could be conducted by Heather Hecht, a recent ASU graduate with a Master's degree in physical anthropology. Isotope analysis, if appropriate, could be carried out by Steven Martin at the UCLA Lab.

The decision whether to excavate or not will be made following consultation with the Kaibab Paiute Tribe and other, interested parties. While the burial is isolated from the main features and can be left undisturbed, future erosion will undoubtedly claim it. Vandalism is also a disturbing possibility. Reburial could be readily accomplished in consultation with interested parties.

Field Methods

A plan and profile drawing of the site has been produced and will be tied into a staked grid system to facilitate remote sensing and the excavation of the features. Overburden (ca 1 m) will be removed by skim shoveling to just beyond the projected edge of the pit features. When cultural deposits are encountered the relationship of the feature and overlying deposit will be determined and the overlying midden and the structure's fill will be removed with trowels in metric or stratigraphic levels.

As noted in the research section, chronology remains a paramount concern in the Virgin culture area. Of particular interest is the determination of just how early the Late PII phase begins. It may be that the dramatic changes in material culture all occur within just a few decades. The internal sequence is also critical to our central research objectives. C14 samples will be collected from each structural feature. The potential for dendrochronological dating is good, although no suitable wood has yet been observed. All suitable specimens will be submitted to the University of Arizona's Laboratory of Tree-Ring Research.

Feature and artifact control will be maintained using the standard "feature" system developed by the University of Utah and used extensively in the Cedar City District over the past 16 years. This system organizes notes into a daily log of observations and also assigns individual numbers to any and all recognized phenomena. Artifact provenience will be controlled by grid unit and/or feature number as well as by level. Artifacts lots from these units will be assigned field specimen (FS) numbers for control from the field, through the lab processing phase, and

on to analysis. Artifact analysis will be accomplished in-house by McFadden and Dalley.

B/W photos and color slides will serve as the photographic record. Copies of all photos, notes and records will accompany the artifactual material which will be curated at the Museum of Southern Utah, Southern Utah University, Cedar City.

BLM archaeologists Douglas A. McFadden and Gardiner F. Dalley will supervise all aspects of the excavation process from initiation, through analysis, to publication. It is intended that the report will wither be incorporated into a Utah BLM Cultural Resource series volume or be submitted as a "Report" to Utah Archaeology. This latter publication is particularly appropriate given our use of volunteers from USAS.

Utah Prehistory Week

It is our intention to make the Arroyo site the focus of an exercise in public archaeology by involving numerous groups and individuals in the excavation and interpretation process. We will coordinate our effort with Utah Prehistory week (May 7-14). Local amateurs from the Arizona Archaeological and Historical Society and the Dixie Chapter of the Utah Statewide Archaeological Society have volunteered to assist in the excavation of the site as well as concurrent processing (cleaning and labeling) of artifacts in the Kanab Resource Area warehouse. Most, if not all, of these people have been through the certification program. Several have proved to be valuable excavators on the Southgate project.

Since the site is somewhat remote and perhaps not accessible to the entire public, a concurrent interpretive display will also be provided in the Kanab Resource Area Office. Personnel will be available at specified times during the week to explain the progress of the excavation as well as our more general program objectives.

As stated at the outset, this data recovery plan is simply the continuation of an approach to cultural resource management that has developed in the Cedar City District over the past 16 years. Lacking large scale or numerous excavation and inventory projects with which to develop the archaeological record, our approach has been to seize opportunities to retrieve data from a great variety of threatening situations. The Arroyo site is only the latest in a long series of such opportunities.

Of equal importance to the salvage of excavation data is the development of a context in can be understood it. The Bureau's primary legislated mandate is to identify, evaluate, and protect a representative sample of the prehistoric record. To this end, on-going intensive inventory focusing on the Grand Staircase has resulted in the identification of several hundred Anasazi sites within the Kanab Resource Area. Data recovery efforts allow this wealth of data to be coherently organized and evaluated. A large number of late PII sites occur along Kitchen Corral Wash. Salvaging the Arroyo site data will pay significant dividends by strengthening the local chronology,and by enhancing our understanding of Late PII subsistence adaptations and the nature of Virgin and Kayenta relations.

Future Protection and Mitigation

Upon completion of excavation work at the Arroyo site we propose to construct a series of earthen "gully plugs." These will be constructed just downstream from the site. Our hope is that the arroyo will naturally fill over a period of years so as to "put it to bed." Adjacent vegetation of sagebrush and juniper trees will be placed in the arroyo to discourage illicit digging by pothunters while the deposits remain exposed. The area surrounding the site has already been reseeded with crested wheat grass. The site itself will be hand seeded to prevent future erosion.

Chapter 3
The Excavations

The field recording method employed at the Arroyo site excavation closely follows Jesse Jennings' "Feature System," commonly used, but unfortunately frequently modified, throughout Utah. In this rigorously descriptive, inductively oriented method, the site is first and foremost objectively described, allowing speculation and hypothesis building to occur only after the rigorous observations of fact are recorded.

THE FEATURE SYSTEM

The feature system recording procedure designates and describes all phenomena, both cultural and natural, as well as analytical units that allow for vertical and horizontal control, as sequentially numbered "features". The initial description of a feature involves a brief objective description and a sketch which are recorded on a Feature Form. Continuation pages allow the feature description to evolve over the course of its excavation. Frequently, a series of associated features will be described along with the initial feature resulting in nomenclature such as "F27 fill within F31 rock alignment." A continuing record of the feature and its relationships is made by the excavator until the feature has been completely excavated.

Concurrently, a daily log, known as the Feature 1 (F1) notes is kept by the principal investigator. The F1 notes are reserved to describe the site itself, excavation strategies employed, day to day progress, and various housekeeping activities. It is also used to make observations and speculations regarding the site, the nature of its features, and relationships between them. The F1 notes serve not only to describe features but also to orient and direct the course of the excavation as it evolves.

When final definition of a feature has been achieved, feature forms are "closed out" by writing a final description and noting relationships. Often, a field interpretation of the feature is offered as well. The final published interpretation of these features normally drops the feature number and assigns a descriptive label such as Storage Room 1, Residential Room 1, etc. This report provides numerous "final" feature descriptions and interpretations: it also describes several partially excavated features that have retained their feature number designations and remain to be explored in the future. Much, or perhaps most, of the Arroyo site remains to be excavated. As such, the Arroyo site is a work in progress. It is expected that features partially explored and described here may eventually be fully excavated, and subsequently interpreted, by simply expanding on the existing observations in the feature notes. The organization of Jennings' Feature system should serve these ends well.

Jesse Jennings provided a thorough description of his procedures used for the Glen Canyon Salvage Project (Jennings 1959). He tersely summarizes his approach to excavation in the following passage: "Archeology is done by moving dirt, and noting relationships, and thinking about them" (Jennings 1959; 687). The following section describes how the dirt was moved.

EXCAVATION METHODS AND PROCEDURES

Following the initial exercise of mapping of the arroyo, drawing profiles of the exposed features, and collecting soil and carbon samples in the fall of

1993, the pre-excavation activity of the spring 1994 season involved clearing brush off a 30 m x 22 m area and gridding it into 2-meter square units (Figs. 3.1, 3.2).

The grid system accommodated a ground penetrating radar (GPR) survey, which attempted to identify the buried portions of features exposed in profile as well as undiscovered, totally buried, features. The results of this survey were negative - possibly due to a problem with the equipment. A subsequent soil auger program identified substantial cultural deposits (Stratum 2) over the entire grid area ranging in depth from 1.25 - 1.50 m + on the northeast corner, to 1.15 – 1.50 m+ on the southeast. Deposits on the west side of the arroyo were generally shallower but yielded indications of features. At point A14, Stratum 2 was encountered at 25 cm and fragments of jacal occurred at 60 cm to 80 cm. At grid point G10, Stratum 2 produced charcoal between 45 cm and 80 cm. Assuming that the site

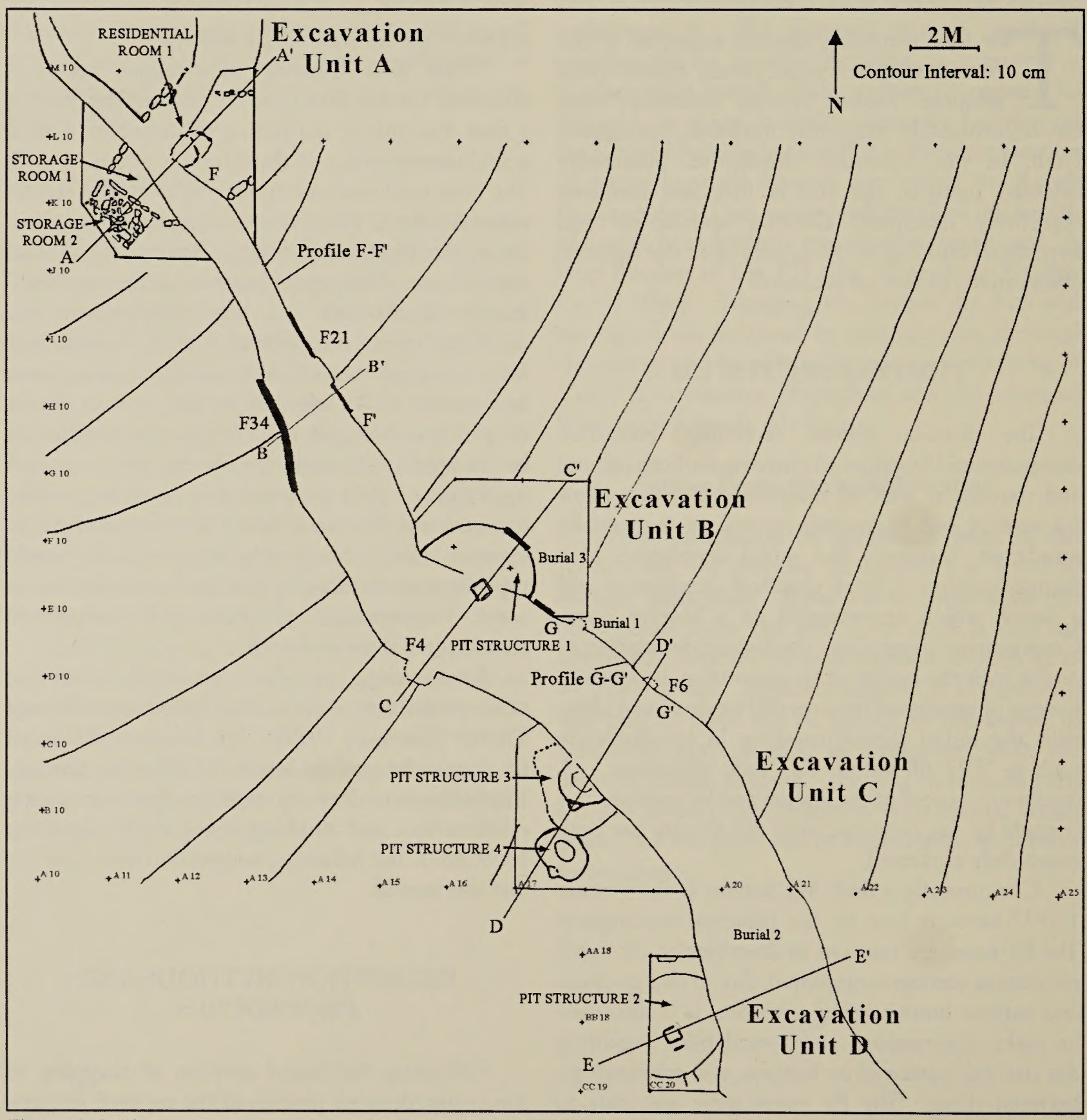


Figure 3.1. Plan, contour, and excavation map of 42Ka3976

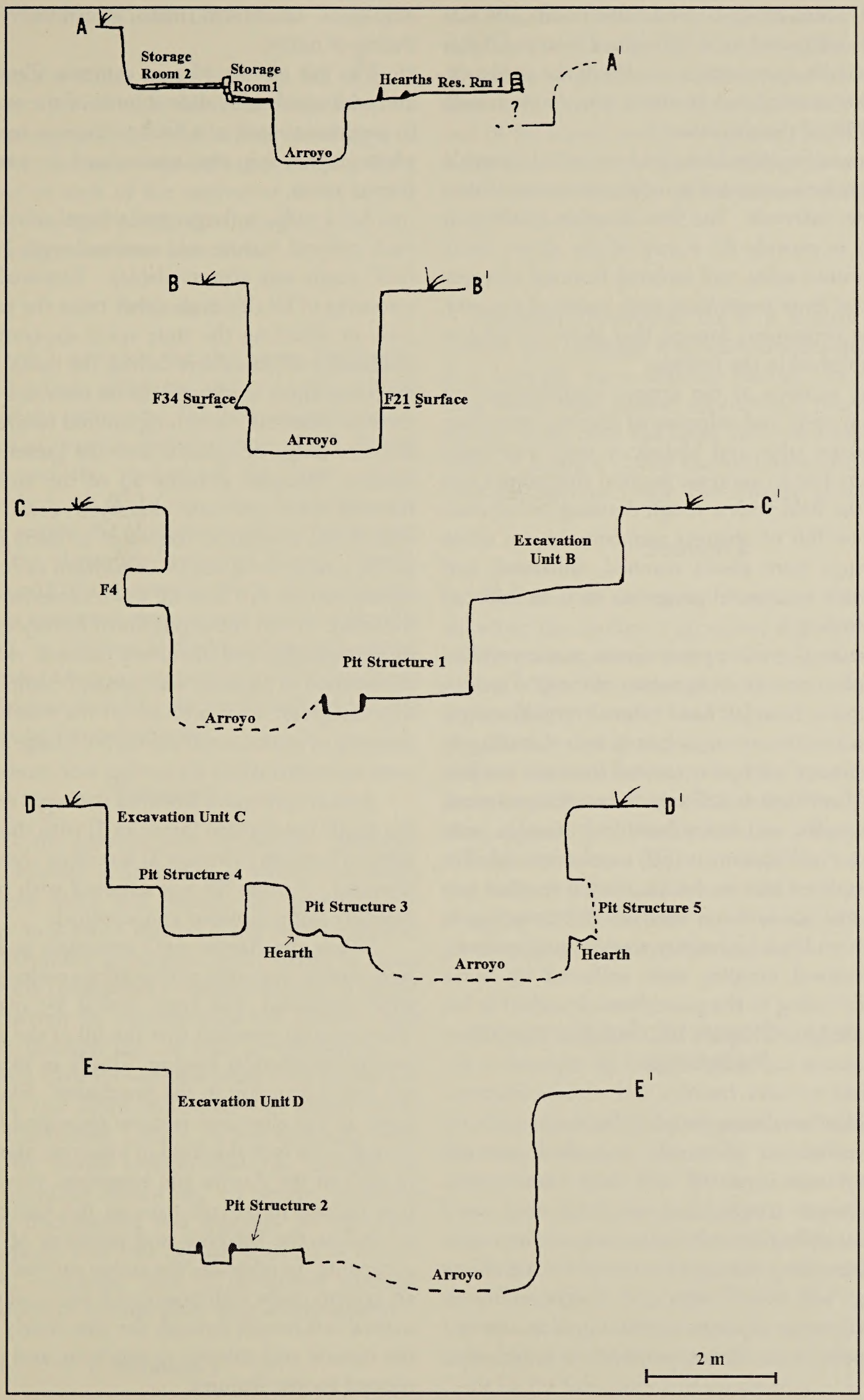


Figure 3.2. Excavation unit/arroyo profile drawings.

does not extend much beyond these points, site size is roughly estimated to be 840 square meters. Of this area, about 40 square meters, or 5% of the total area, were either washed out by the arroyo or excavated, leaving 95% of the site intact.

A second function of the grid system is to provide data points for a contour map of the site surface based on 2 meter intervals. The final function of the grid system is to provide for a map of the arroyo itself, the excavation units, and isolated features. Deeply driven steel fence posts mark each corner of the grid, providing permanent datums that allow the grid to be reestablished in the future.

Cross sections of the arroyo, establishment of excavation units, and mapping of features were done with a plane table and alidade, a very traditional technology but an accurate method that allows one to leave the field with a rough drawing rather than a notebook full of abstract numbers. In the office all drawings were photo scanned, enhanced, and labeled with automated programs such as Autocad and Photoshop.

Horizontal artifact provenience was controlled by the alpha-numeric designation of the grid system (read from the lower left hand corner): vertical control of the excavation was maintained by excavating in 20 cm arbitrary levels as measured from the modern surface. All artifacts as well as radiocarbon specimens, pollen samples, and macrobotanical samples were assigned a Field Specimen (FS) number recorded in the F1 catalog. Once in the lab, the FS number was dropped and the artifacts were labeled according to the Southern Utah University accessioning system.

Macrofossil samples were collected by Steve Martin according to the procedures described in his research design (Chapter 10). Samples were taken from a column in Pit Structure 1 fill exposed in the arroyo, floor surfaces, hearths, and selected features.

Radiocarbon dating sample collection procedures stressed collection of small, twig-sized material apparently used in wattle and daub construction. Where larger construction material was used attempts at collecting only the outermost rings were made. Even these attempts to control for the effects of dating "old wood" were not always sufficient. The initial series of dates produced some obvious discrepancies, necessitating subsequent rounds that employed accelerated mass spectrometry (AMS) dating of maize.

The use of two 35 mm cameras allowed black and white and color slide records of the excavations in progress as well as a final excavation record. The photographic log was maintained as part of the feature notes.

As a rule, a large percentage of the fill of each cultural feature was screened with 1/4" mesh (1/8" mesh was also available). Essentially, 100% screening of fill demands either twice the excavation crew or doubling the time spent excavating. The availability of volunteers during the initial stages of the excavation made this labor intensive recovery method practical. Screening insured recovery of the full size range of cultural material present in each feature. Because virtually all of the architectural features were partially destroyed prior to their excavation, numerical counts of artifacts recovered in the screen could not be considered as statistically representative. All floor fill was screened or carefully troweled. Given the depositional history of the site, its stratigraphy, and disturbed features, variation in the method of recovery was justified (although some may disagree). Even with use of the screen, the vast majority of artifacts and debris, both large and small, were recovered while excavating with trowels.

Actual excavation involved the rapid removal of the sterile overburden (Stratum 1) with shovels. The cultural horizon (Stratum 2) was skim-shoveled and troweled. Feature fill was removed with trowels or carefully skim-shoveled and screened.

While the Arroyo site's structures and features were mostly remnants, with portions entirely missing, what remained had been sealed by overburden. There was no question that the fill of the structures was undisturbed by looting. This is an ideal and all too rare a situation in the Southwest. Many, if not most, of the sites and features excavated in south-central Utah lack this kind of integrity. Significantly, in each of the Arroyo site structures, it was the fill that yielded important data on the history of use, as well as the behavior and practices of the site's occupants. In addition, the arroyo cut itself provided an exceptionally well positioned and uninterrupted natural test trench through the site, clearly exposing the natural and cultural stratigraphy, and providing context for the features.

SITE STRATIGRAPHY

One of the initial exercises in the fall of 1993 was to draw a profile of the east bank of the arroyo to note the stratigraphy and the relationships of exposed features to it. Strata, as exposed in both banks of the arroyo, and in each of the excavation units, appear straightforward and consistent throughout the site. The following strata were identified.

Stratum 1

Stratum 1 accounts for the upper one meter of deposit which postdates and seals the cultural deposits of the entire site. The well-defined stratum consists of as many as sixteen lenses of red alluvial silt, sand, and clay washed off the terrace slopes immediately north of the site. The observation of a cow bone within the alluvium suggests that at least some of the deposition occurred during historic times (circa 1870's to present). No in situ artifactual material or structural stone occurs in this culturally sterile unit. In addition to the finer deposits, isolated gravel lenses of varying coarseness provides evidence of material introduced by the wash itself prior to its down-cutting through the site.

Stratum 2

This is the primary cultural deposit identified on site. Stratum 2 definition is visible just south of the room block and extends for approximately 40 meters to a point located a few meters beyond the southernmost excavation unit, where it fades out. Initially considered a midden deposit, it might more accurately be considered a soil horizon that developed through use, as well as deposition. It appears as a dark brown stain with only occasional small rock and sherd inclusions. In several areas (notably Excavation Unit 3), it has obviously been trimmed by fluvial erosion that has reduced its original thickness somewhat. In general, however, it appears undisturbed and averages 50 cm thick. It is significant that this deposit seals all of the pit structures, indicating that it developed through continued use of the site after their abandonment.

Stratum 3

This stratum forms the surface on which all of the structures and features originate and into which they are cut. The deposit is a consolidated red clay, alluvial in origin, but undifferentiated and without obvious laminates. At its deepest, towards the south end of the arroyo, well over one meter of the deposit is exposed. On the north, underlying the room block, only a few centimeters of the deposit were exposed in the arroyo cut.

Stratum 3A

Stratum 3A overlies the F12 Archaic feature/ surface, and although it appears identical to Stratum 3, it logically has a different history. Its similarity may result from similar depositional processes (i.e. alluvial wash from the slope above the site). In his study of Kitchen Corral alluvial history, Kulp (1995) calls the Stratum 3 unit "Pre-Anasazi alluvium."

Stratum 4

The level of the arroyo floor, and the apparent substrate that makes it up, varied during the course of the investigations due to two significant flood events. The last event flushed out much of the accumulating backdirt and exposed a light gravel deposit. A shovel and auger test into the deposit did not find the bottom. A probe beneath the Pit Structure 1 floor revealed that it lay directly on blue clay, apparently a Petrified Forest Member of the Chinle Formation deposit. Whether clay forms the bedrock substrate, is naturally re-deposited, or was purposefully laid was not determined before the level was refilled by another rainstorm.

EXCAVATION UNITS AND CULTURAL FEATURES

Four excavation units were established above the major features identified in the arroyo cut. Designated Units A - D, they were designed to encompass the features and expose the surrounding adjacent occupational surfaces (Fig. 3.1). Each unit was laid out as part of the overall grid system. From north to south they include: Unit A, the room block (30 sq. m); Unit B Pit Structure 1, (approximately 20 sq m); Unit C, Pit Structures 3 and 4 (20 sq. m); and Unit D, Pit Structure 2 (8 square m.).

Features exposed in the arroyo walls (Figs. 3.1,

3.2) that were not completely excavated include: F21/34 Archaic level surfaces, F4 niche, F5 (Burial 1), and the F6 hearth. These features will be described separately.

Rather than being isolated and cut off from one another, the above features and excavation units are stratigraphically related via the arroyo walls themselves which served well as a test trench that extended approximately 40 meters.

Excavation Unit A

Excavation Unit A was established to explore what appeared to be a room block exposed in the alluvium about 20 m east of the base of the ridge (Figs. 3.3, 3.4). The arroyo forks on the north edge of the site providing three exposures of cultural debris; on the west side a 2 m wide deposit of structural rock and clay, bounded by large sandstone blocks, indicated a probable room; the central segment displayed an alignment of large rock - possibly a continuation of the room noted on the west; the right fork of the arroyo exposed in profile an extensive occupational surface with several layers of clay, ashy fill and small twigs overlying it, and a large ash filled feature which later proved to be the remnants of two superimposed hearths. Ultimately, portions of two storage rooms and a residential room were excavated. Both the storage and residential components showed evidence for a complex construction history indicating multiple occupational episodes.

Residential Room 1

This large, possibly irregularly shaped, jacal surface room was cut by the arroyo and excavated as two separate features (Figs. 3.5, 3.6). Eventually, a single room was recognized as defined by similar fill and a floor surface bounded by rock wall alignments of similar size and construction. The eastern remnant of the room showed good evidence for two occupational surfaces. The definition of two surfaces was supported by the superpositioning of hearths A and B (Fig. 3.7). The occurrence of two occupational surfaces was not obvious in the room remnant lying on the west side of the arroyo. Underlying the occupational fill of Residential Room 1 on the west side of the arroyo was the floor of Storage Room 1, as described below.

Fill of West Remnant

Overburden consisting of Stratum 1 alluvium, 40-45 cm deep, overlaid the cultural features in this portion of the excavation unit. Structural fill consisting of clay, small rock including spall, and some evidence of burning, was encountered at about the same depth as the rock wall alignments on the northwest and southwest. Approximately 30 cm of fill, originating from the top of the encircling course of rock, was carefully removed with the expectation of defining two floor/occupational surfaces, as were apparent in profile and in the eastern room remnant.

Figure 3.3. In progress view of Excavation Unit A, facing southeast.

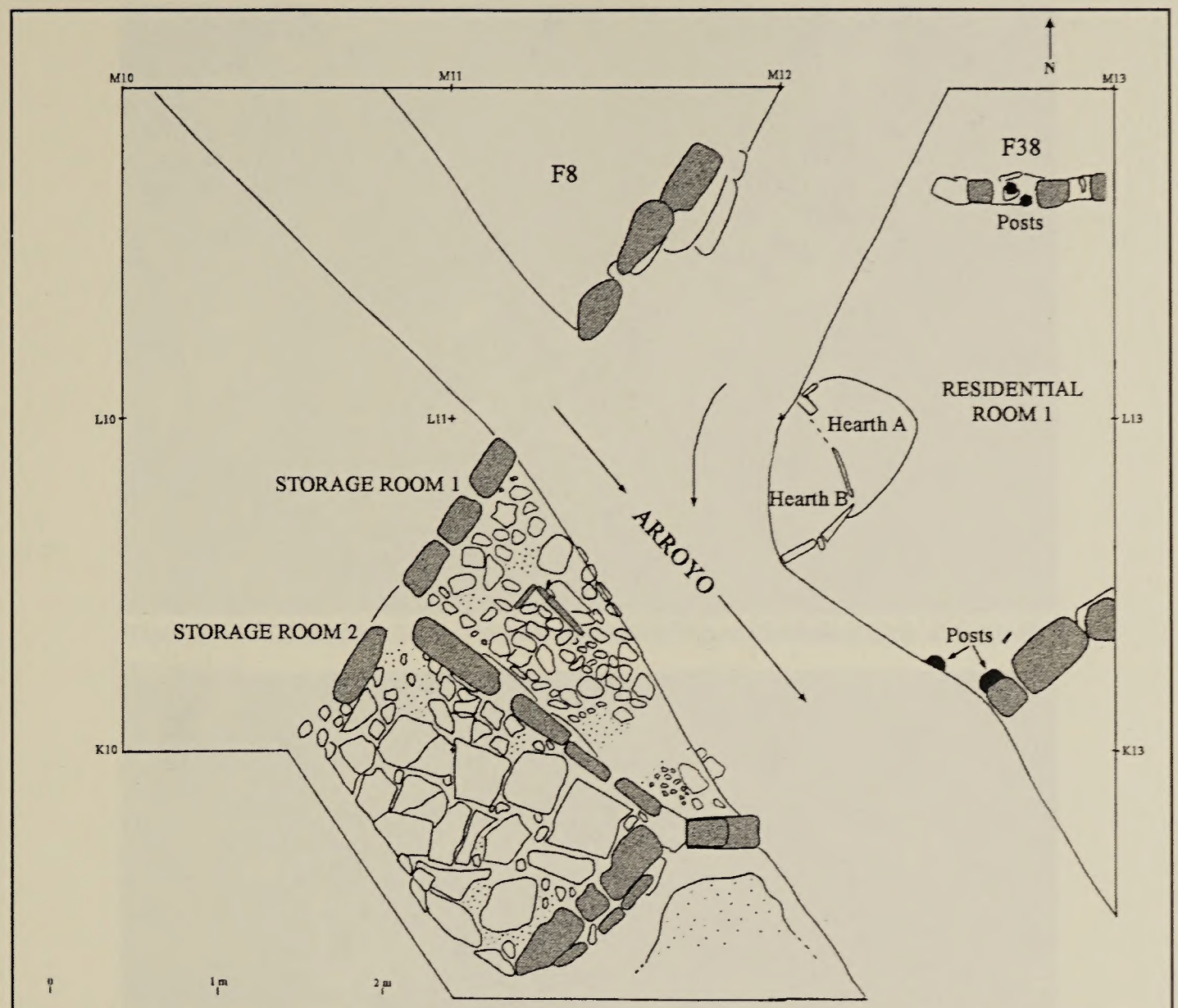


Figure 3.4. Plan map of Excavation Unit A

Upper Floor Surface. A poorly defined floor surface of mottled clay covered with ash was overlaid by massive clay and rock fill. Floor contact artifacts included a large, partially restorable worked panel of corrugated Shinarump gray ware, a spindle whorl, and a two-handed mano. A few tiny daub fragments, charcoal, and burned rock suggested that the structure may have burned.

Lower Floor Surface. Sealed beneath the upper clay surface is an ashy deposit containing charcoal within a matrix of burnt clay up to 23 cm thick that was visible in the profile of the arroyo cut. This deposit is interpreted to be the result of a collapsed jacal wall. The jacal debris lay directly on an uneven clay surface which was laid over the rock subfloor that defined Storage Room 1 (Fig. 3.8). An excellent quality sample of small carbonized twigs yielded a calibrated radiocarbon date of cal A.D. 1045-1105 and A.D. 1115-1290 with a midpoint of A.D.1235 (Beta 77117).

Discussion. The upper structural clay and rock deposit accounts best for the most recent occupation of Residential Room -1. The underlying surface, in part defined by contact artifacts, appears to be a cleared and smoothed surface created in jacal rubble that corresponds with an earlier use of Residential Room -1. Much of the jacal was probably cleared out to prepare it. It is worth noting that a great deal of jacal debris was encountered in the upper post-abandonment fill of Pit Structure 1 located 10 m to the southeast. Although the debris is not necessarily directly related, these trash deposits indicate that the process of remodeling surface structures on one portion of the site may be recognized in deposits found elsewhere.

A single radiocarbon date of 820 BP +/-60 (Beta-77117) was obtained from the small carbonized twigs in the jacal debris that lay directly on the lower floor surface. The calibrated result of this date was consistent with the two dates obtained from

Figure 3.5. Initial definition of Residential Room 1, east remnant, facing east.

Figure 3.6. Final definition of Residential Room 1, east and west remnants, facing west.

the surfaces on the eastern remnant of Residential Room, as described below.

Description of East Remnant

The fill of Residential Room 1, on the east side of the wash, was initially visible in profile as a 2 meter long lens of small diameter charcoal fragments located immediately above a band of orange clay. This apparent jacal wall section lay on a thin lens of ash in direct contact with a sandy clay surface that was later determined to be the upper floor of the structure (Fig. 3.9).

Fill. The entire excavation unit on the east side of the arroyo was sealed by 60 cm of Stratum 1 alluvium, characterized by several lenses of sorted gravel. Stratum 2 also sealed the entire structure with a 25-30 cm thick level of unstratified alluvial clay. Structural deposits were variable and accounted for the lower 25-30 cm of fill, which lay in close contact with the floor surface of compacted clay. Upper structural fill was dense reddish brown clay with small rock which was particularly evident along the north wall. Lower deposits consisted of ash lenses, small diameter charcoal, and bands of clay. These lower deposits were generally consistent with the

Figure 3.7. Detailed view of Residential Room 1 Hearths A and B, partially excavated.

Figure 3.8. View of Residential Room 1 fill, west remnant.

initial profile observed in the arroyo cut bank and also with the east wall of the excavation unit.

Floors. Although not conclusive, Residential Room 1 did eventually yield evidence during its excavation for having two occupational surfaces. The lower floor was partially covered with up to 10 cm of charcoal-ridden ashy, fill overlying a fire-hardened clay surface. In several places the debris was covered with 2 or 3 cm of unburned bright orange clay that was taken to be the upper occupation surface (Fig. 3.9). Both surfaces are defined by lenses of clay and thin laminates of burnt structural debris. The F–F' profile (Fig. 3.12) suggests that the lower floor extends beneath the southeast wall of Residential Room-1. This apparent anomaly was not resolved.

Underlying both occupational surfaces of Residential Room 1 is a dirty, mixed, clay fill, approximately 10-15 cm thick and apparently structural, which overlies a burnt surface (F43) lying directly on the Stratum 3 sterile clay. These deposits strongly suggested that Residential Room-1 overlay an earlier structure, one that was probably associated with the F38 alignment (Fig. 3.9).

Hearths A and B. Supporting evidence for multiple occupations of Residential Room 1 comes from the remnants of two superpositioned hearths

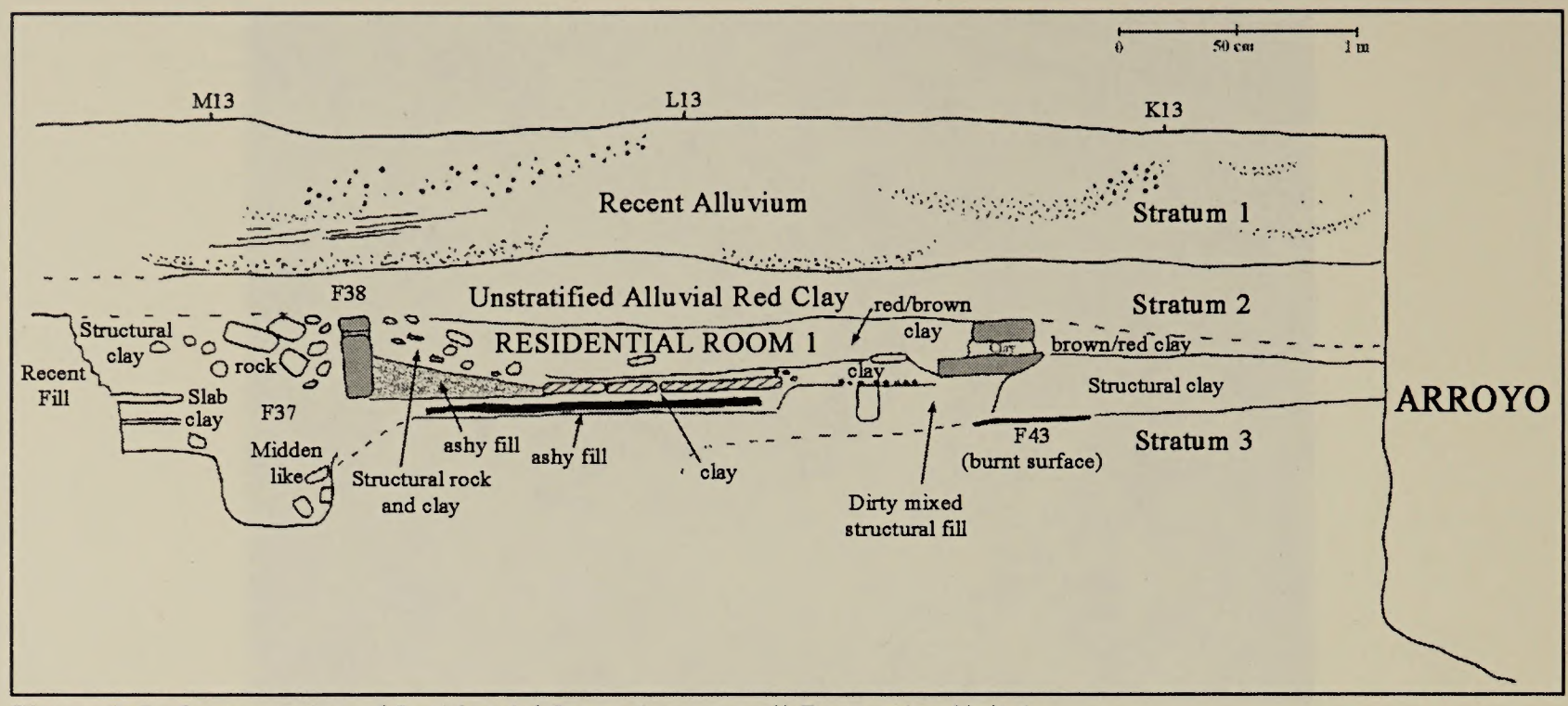


Figure 3.9. Cross-section of Residential Room 1, east wall Excavation Unit A.

designated A and B (Fig. 3.7). The hearths were initially visible in the bank of the arroyo. Fill of both consisted primarily of well-combusted gray ash. The upper, Hearth B, is a shallow basin, lined with four rough sandstone slabs set partially into the floor and partially into the fill of Hearth A. About 50% of the feature remained intact. The remnant is "L" shaped suggesting that its original form was square.

About 50% of Hearth A was cut away by the construction of Hearth B. It was also constructed as an apparently square basin lined with sandstone slabs. Three slabs remained along its northeastern edge. The maximum size diameter both features was probably about 70 cm. The depth of each was approximately 10 cm.

Macrobotanical samples collected from both Hearths A and B yielded a relatively high seed density including maize kernel fragments. This suggested to the analyst that seed processing activities (especially maize) had taken place in Residential Room 1 (see Chapter 8).

Wall Construction. The walls seemingly containing and defining the Residential Room 1 fill, floors and features consist of six separate segments isolated from one another by the "Y' shaped arroyo that cut through the floor of the structure. Further complicating the description of the wall construction is the apparent remodeling of the adjacent storage room block to serve as the north and west walls of the structure.

The western remnant of Residential Room 1 is defined by the masonry alignments of Storage Room 1. On the south, remodeling of the room block is suggested by a short segment apparently angled to meet the wall remnant on the opposite side of the arroyo (Fig. 3.4). On the north, a totally isolated segment of up to three courses of large stone (F8) appears to be an extension of the storage room block. The purposefully selected, but not dressed, sandstone blocks forming the alignment are similar in size and shape to those forming the walls of Storage Rooms 1 and 2.

The best wall definitions for Residential Room 1 are the remnants located on the north and east that are in direct association with the upper floor (Fig. 3.4). Rock alignments here are generally single courses with small-diameter posts incorporated into them. This type of foundation is common in the Virgin culture area and is consistent with the burnt jacal/wattle-and-daub remains found on the floor of the room.

The overall configuration of the room was not determined due to the limitations of the excavation unit. There is also the possibility that the apparent wall associations are more complex than this interpretation suggests. In general, however, the size, floor preparation, jacal construction, and the presence of hearths argue for use of this portion of the room block as a residence for at least part of the year.

Artifact Associations. Floor contact artifacts in Residential Room 1 were abundant and varied,

suggesting that a variety of domestic functions took place in the structure. They included: sherds (50), chipped stone flakes (4) and tool fragments (2), unmodified bone fragments (1), cobble scraper (1), chopper (1), ground stone fragment (1), pendant (1), modified sherds (4), a perforated disk (1), and a mano. The floor assemblage was consistent on both sides of the wash, which reinforces the interpretation that it was once a continuous floor surface.

Dating. Two radiocarbon dates were obtained from small carbon samples collected off the floor surfaces of the east remnant of Residential Room 1. A conventional age of 950+/-60 BP (Beta-77110) was collected from the lower surface and a date of 860+/-50 BP (Beta-66335) was obtained from the upper floor, both are roughly coeval with material that was collected from the west remnant that dated 820+/- 60 BP (Beta- 77117).

Evidence for Pre-Residential Room 1 Occupation

Feature 37. Feature 37 is a deep, partially explored, unit of fill located in the northeast corner of Excavation Unit A, adjacent to the north wall of Residential Room 1 (Figs. 3.9, 3.10). Its relationship with Residential Room 1 is unclear; while it generally appears to abut the room, a small portion underlies it (Fig. 3.9). As exposed in the bank of the arroyo, the deposit is approximately 80 cm deep. Recurrent flooding of the arroyo constrained definition of both the bottom and west side of the feature.

The fill of Feature 37 was an extremely trashy deposit of structural clay, rock, jacal debris, charcoal, and ash. It appeared to be a purposeful and concentrated dump - possibly into an abandoned pit structure that truncated the floor of Residential Room 1. If this was the case, the north wall of the Residential Room-1 may actually be associated with a later structure. Mixed through the deposit were a variety of artifacts including: an assemblage of Late Pueblo II sherds (108), biface preforms (2), flakes (3), hammerstones (3), a pestle (1), chopper (2), and a single unmodified bone.

Feature 43. F43 (Fig. 3.9) is defined as a surface, with jacal structural fill lying directly on it, that underlies Residential Room 1. The surface occurs 10 cm below the Residential Room 1 surface as well as the Residential Room 1 wall on the south. The surface associates well with two post remnants exposed in the profile (Figs. 3.11, 3.12). It occurs at the same level, or just above, the multiple surfaces which extend eight meters to the southeast of the room block that were exposed in the arroyo bank and defined in profile only (Fig. 3.11). These features consist of pits, lenses of ash, clay surfaces and a hearth (F44). Ceramics observed in the profile were consistently Late Pueblo II. All of these features overlie the F21 Archaic pithouse, which was also exposed in the profile.

Figure 3.10. View of F37 fill north (on left) of Residential Room 1 floor.

Figure 3.11. View of F-F' profile in arroyo cut, Residential Room 1 floor on left.

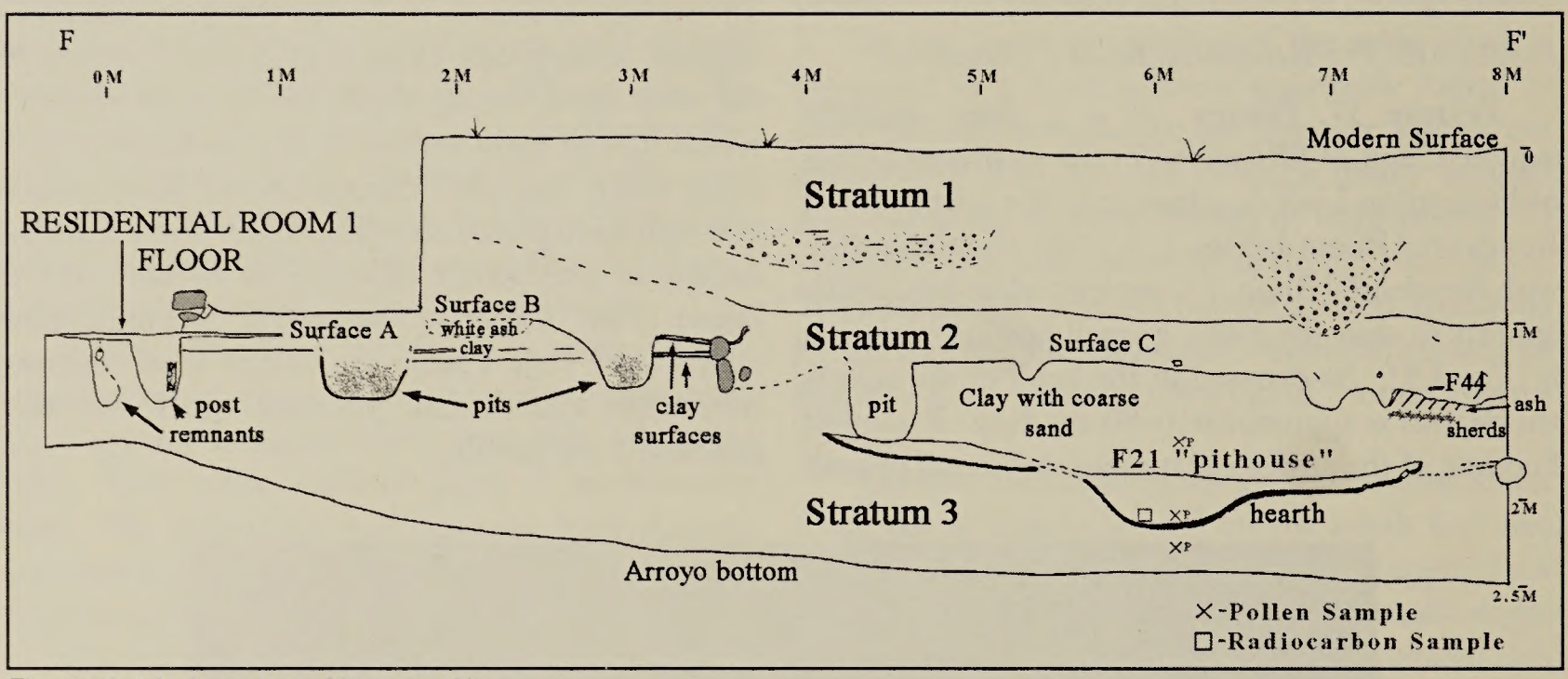


Figure 3.12. Drawing of F-F' profile.

Storage Room 1

Storage Room 1 is the northeast remnant of two storage rooms which, in part, define the masonry room block (Fig. 3.4). The upper two occupational surfaces of the structure are associated with the occupation of Residential Room 1 described above. The lower floor, associated with the storage component, is constructed of small sandstone cobbles/fragments set in clay (Fig. 3.13). The pavement is not continuous, although it does lap up against the common wall with Storage Room 2. The pavement was purposefully constructed but did not appear to constitute a typical sealed sub-floor. Although there is no evidence for an upper slab floor, it is possible that one was removed to lower the floor when Residential Room 1 was constructed.

The lower walls of Storage Room 1 were formed on the northwest by a substantial rock alignment similar in size and construction to the alignment on the opposite side of the arroyo. On the southwest, the room has a common masonry wall with Storage Room 2.

Floor Feature. A single floor feature, consisting of two upright slabs, protruded from the cobble pavement of Storage Room 1 (Figs. 3.4, 3.13). The larger slab lay over the cobble surface, the smaller

one was set into the pavement. No function for the feature could be inferred. It is probable that the uprights were associated with the upper occupation surface associated with Residential Room 1, rather than the storage room itself.

No artifacts or macrobotanical samples were positively associated with the Storage Room 1 pavement. No radiocarbon samples could positively be related to the surface but, obviously, it predates the overlying floor surface of Residential Room 1 which yielded a conventional date of 820 +/-60 BP (Beta 77117).

Storage Room 2

Storage Room 2 was an undamaged, but only partially excavated, room adjoining Storage Room 1 on the southwest (Figs. 3.4, 3.14) Its northwestern edge appears to be part of a continuous wall alignment forming the room block. The alignment is constructed of sizable (30x15x15 cm) well selected, but not dressed, sandstone blocks. It is defined on the southeast by a roughly parallel alignment of similar stone, and on the northeast by a partition wall that separates it from Storage Room 1.

The fill overlying the room consisted of 50 cm

Figure 3.13. View of Storage Room 1 floor pavement

Figure 3.14. View of Storage Room 2 facing southeast with floor clay partially removed.

+ of Stratum 1 alluvium. This alluvial fill, including a lens of marble-sized gravel, lay directly on a dense purple clay (Petrified Forest Member of the Chinle) that was used to surface the floor of the room and, presumably, to construct jacal walls. A prepared floor surface in the Chinle clay was identified a few centimeters below the top of the partition wall. In a few places slabs protruded through the clay. The floor surface was clean with no apparent use deposits.

In places, fully 10 cm of purple clay and tabular rock overlaid a lower pavement of slabs set in a matrix of orange clay, which suggests an earlier construction episode. A pollen sample from the lower surface yielded small quantities of Apiaceae, *Cleome* sp, *Cylindropuntia*, and *Zea mays*.

Discussion. The sub-floor pavement of storage Room 2 is constructed of tightly fitted sandstone slabs overlaid by a thick clay surface. An apparent lower floor, set in a matrix of orange clay, suggests an earlier building episode.

Substantial sealed floors in storage rooms are a hallmark of Virgin Anasazi storage technology (Dalley and McFadden 1985). Rebuilding, or laying of additional floors, presumably during the course of a remodeling episode, is not uncommon. The lack of slab uprights around the perimeter of the room is, however, a notable departure from typical Virgin Anasazi storage room construction.

Extramural Features

Occupational Surface A. This surface (Figs. 3.11, 3.12) was visible in profile, but was not explored. It is the lowest of two external surfaces that lie immediately south of Residential Room 1. It appears to run underneath the southeast wall of Residential Room 1 and therefore predate it. Overall, it is approximately 3 m long. It may associate with floor remnant F43 which also lies under Residential Room 1 (Fig. 3.9). A small pit appears to be associated.

Occupational Surface B. Surface B (Figs. 3.11, 3.12) overlies Surface A. It exhibits a pit or basin that intrudes into surface A. The level of origin for Surface B is at the approximate level of Residential Room 1. A pocket of white ash lies on, or just below, the surface. As defined, Surface B is a little less than 2 m long. Stratum 2 alluvium seals the surface. Both Surfaces A and B are truncated by two small rocks on the south. It is possible that the surfaces are associated with a ramada constructed immediately south of the room block.

Occupational Surface C. Surface C (Figs. 3.11, 3.12) lies at the same level as Surface A and could be a continuation of it; however, it is truncated on the south by the small rock that bounds Surfaces A and B. Like Surface B, it also displays a pit and is terminated on the south by hearth remnant F44. The surface is approximately 3.25 m long. Like Surfaces A and B, this use surface could represent either an open occupation area or an activity area covered by a light structure or ramada.

Feature 44. F44 (Fig. 3.12) is a bowl-shaped hearth remnant 53 cm wide and 13 cm deep exposed in the east wall of the arroyo. Its contents are ashy and consistent with hearth fill. The feature was initially left intact. Subsequent slumping exposed a crushed, restorable, corrugated vessel near the bottom of the feature. Interest in the vessel by the public prompted its recovery along with a large macrobotanical sample (not analyzed). The two bags of sherds collected are not included in the overall tabulations.

Excavation Unit A, Descriptive Summary

The rooms and features which comprise the room block in Excavation Unit A are an excellent example of an extremely complex archeological record that reflects a site history of multiple construction and use episodes.

The extramural pits, use surfaces, and hearths described in the area south of the roomblock were minimally explored, but illustrate the complex nature of activities "in front" of the room block. Stratification of the surfaces is consistent with the several building and remodeling episodes of Residential Room 1.

Emphatically, excavating Virgin room blocks is not simply a matter of "clearing rooms." The room block, as the focal point of activity on site, is key to reconstructing the site's history and understanding the prehistoric behaviors that took place on it. Because the room block is usually the most durable architectural feature on site, outlying features (i.e. pit structures, activity areas, middens, burials etc.) can, potentially, be related to it. Ideally, the remodeling episodes, repaving of floors, demonstrations of superpositioning, sequence of room construction, observations on abutting/bonding wall techniques, and associated multiple occupation surfaces, can be related to extramural features located elsewhere on site.

Room block Construction Sequence

1) Prior to construction of the room block, Features 43 and 37 indicate the existence of substantial architectural features – probably residential in nature (Fig. 4.2).

2) Structures represented by F43 and F37 were abandoned and razed. The storage portion of the room block was composed of at least 2 rooms, Storage Room1 and Storage Room 2.

3) Residential Room 1 was constructed by remodeling and intruding into Storage Room 1. It seems likely that an upper slab pavement was removed from the storage room, although this could not be demonstrated.

4) Residential Room 1 was abandoned and re-occupied as evidenced by the superpositioning of Hearths A and B. Both Residential Room 1 and Storage Room 1 also display evidence of two occupational surfaces.

5) Occupational Surfaces A, B and C appear to associate with the occupational episodes of Residential Room 1.

6) Storage Room 2 floor appears to have been rebuilt - possibly at the same time as the remodeling of Residential Room 1.

7) The sequence is terminated, on this portion of the site, by flooding and sealing of the deposits by Stratum 2 alluvium.

Significance of the room block. While the sequence is straightforward, what is not clear is the relative timing of these events in terms of behavior. More to the point, what are the intervals of time between the events and what precipitated them? Do they actually correspond with reoccupation after episodes of abandonment? If so, does abandonment correlate with external local degradation (i.e. down-cutting episodes, firewood depletion etc.)? Does the data support expectations for the Virgin Pattern residential mobility model? Is the temporal scale of remodeling annual, i.e. on the level of a single generation, or do decades occur between episodes, suggesting that multiple generations are involved? What are the social implications for each? Does a pattern of reoccupation indicate family continuity, reuse by different household groups or, possibly, even reuse by different ethnic groups?

What is clear is that the Arroyo site, and specifically the room block, was the focus of long-term residential activity related to farming local arable plots. The outlying use surfaces, pit structures, and burials described in Excavation Units B, C, and D are all stratigraphically related to the complex sequence of events that occurred in Excavation Unit A.

Excavation Unit B

Excavation Unit B lies 10 meters southeast of Excavation Unit A (Figs. 3.1, 3.2). Excavation Unit B is nearly triangular in layout and encompasses approximately 12 square meters. It was designed to explore the 2 meter wide exposure of fill in the north wall of the arroyo eventually designated as Pit Structure 1 (Figs. 3.15, 3.16 and 3.17). Pit Structure 1 was the largest and most obvious feature initially observed on the site. The ashy, organic laden, midden-like fill promised to be a rich source of subsistence data with good dating potential. It was also the most sensitive feature on site, subject to both erosion and even casual damage by visitors.

Upper fill of the excavation unit consisted of up to 90 cm of recently deposited Stratum 1 alluvium. Stratum 1 in this area of the site consisted of cross-bedded lenses of gravel, sand, and clay. Stratum 2 overlay most of the structure and averaged 25 cm thick. On the northwest edge of the upper fill of the structure, Stratum 1 deposits, along with a pocket of re-deposited sherds, lay in direct contact with the Stratum 3 occupational horizon (Fig. 3.16). Pit Structure 1 originated at the base of the Stratum 2 occupational level, indicating that considerable activity took place on site not only after it was abandoned, but after the sizable pit had been filled with trash.

Stratum 1 overburden was removed by skim shoveling until the cultural deposits of Stratum 2, which overlaid Pit Structure 1, were encountered. Pit Structure 1 fill was excavated in arbitrary 20 cm levels measured from the modern ground surface at stake E18. Quarter-inch mesh screening of deposits was carried out when personnel were available. Approximately 50% of the deposits were screened. Careful troweling of the fill produced a similar artifact recovery rate.

Two distinct levels were identified in the fill of the structure: Level 1, the lower 30 cm of structural debris, associated with the roof and walls, rested

Figure 3.15. View of Excavation Unit B, facing northeast.

directly on the floor; Level 2 accounted for the overlying 120 cm of fill which represents complex, post-occupational, activities. These activities included interment of Burial 1, long term use of the pit as a midden repository, and dumping of structural debris from a razed structure elsewhere on site.

Pit Structure 1

Level 2 Fill (Upper). Although the profile of Pit Structure 1 (Fig. 3.16) appeared to be straightforward, the initial definition of its level of origin, at about 110 cm below datum, was hampered by several shallow depressions cut into its fill, as well as into the northeast wall. Fill of these apparent prehistoric excavations consisted of building clay, minor amounts of rock, jacal fragments, charred timbers, and small stick fragments. Mixed in with this obvious structural material was midden refuse including sherds, small tools, a partially reconstructable corrugated vessel, both large and small scrap bone, and a partially articulated canine. The overlying upper fill (100-140 cm) was difficult to separate from the trash fill within the pit structure itself. It is possible much of the uppermost fill was disturbed and redeposited when a pit was excavated for Burial 3. The burial lies at a depth of 240 cm. The shallowness of the grave pit, however, suggests that the structure was only partially filled when the grave was prepared, and, the fill was subsequently dumped onto it.

In general, the Level 2 fill of Pit Structure 1 showed no discernable variation in disposal/discard patterns from top to bottom. The deposits were well stratified with a dozen or more 3-5 cm thick lenses of ash with lenses of orange clay in a general matrix of very loose, ashy, brown, fill with small chunks of charcoal. Small rock was scattered throughout the deposit. Nearly all this material seems to represent the dumping of individual loads of household debris into the abandoned structure. Artifact counts and diversity remains high throughout the deposits, including a surprising number of worked sherds, disks and spindal whorls, bone awls, and an extremely high ceramic count (over 3,000 sherds). Perhaps as relevant is the lack of chipped stone tools and debitage in the deposits (Table 3.1).

Essentially the same fill continued to 275 cm below the ground surface, but with numerous lenses of ash/charcoal dumped in with variously sized bone and generally smaller sherds. Masses of orange clay near the pit edges were attributed to slumping of the walls. Large quantities of broken vessels and artifacts, as well as serviceable tools, occurred in the fill (Table 3.1). The artifact-rich nature of this lower midden fill unit suggests it may have accumulated over a period of time, while the upper level, containing more structural debris, might represent accumulation over a relatively brief period.

Level 1 Fill (Lower). Level 1 fill is the structural debris from the roof and upper wall collapse of Pit Structure 1. It lies directly on the floor of the

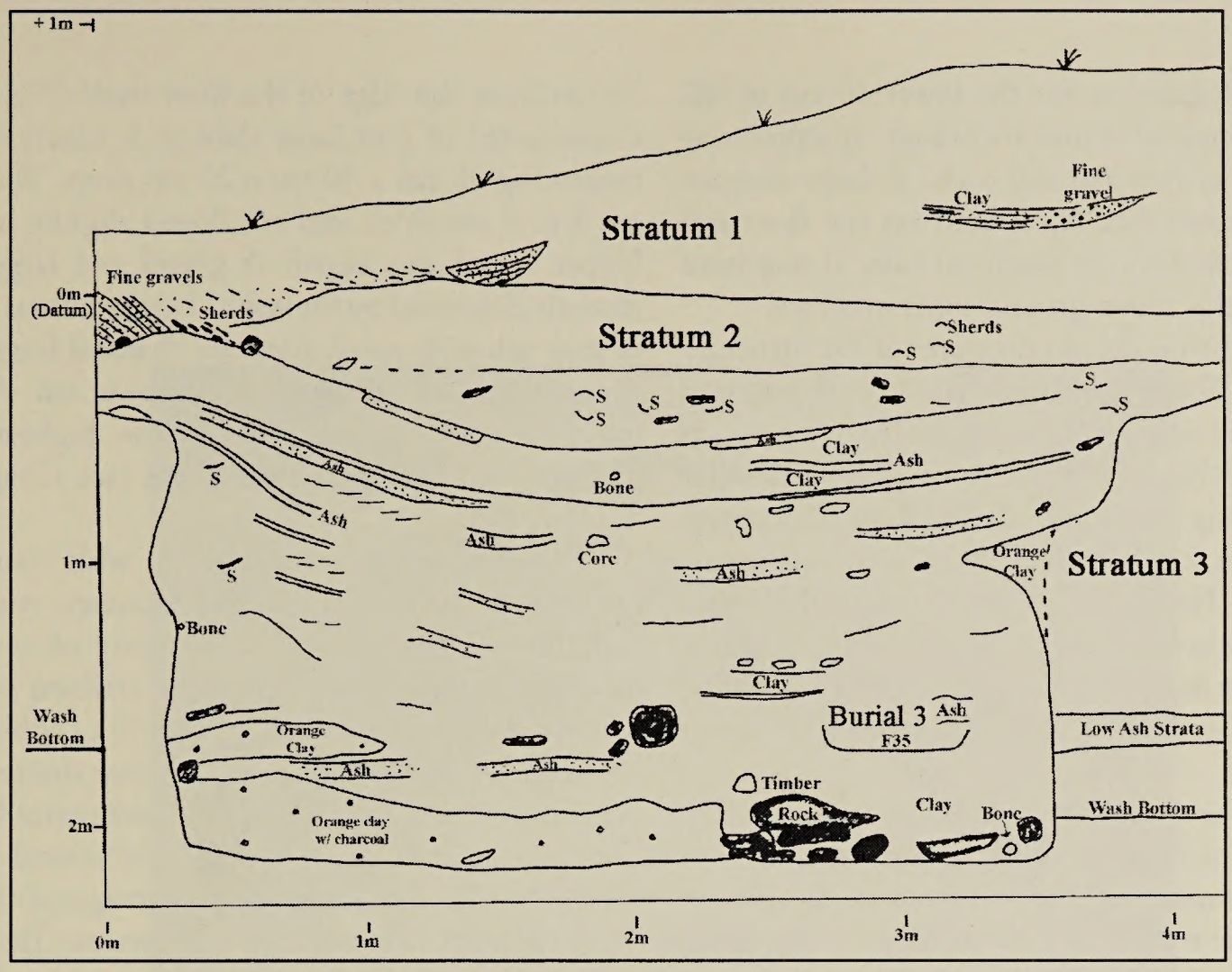


Figure 3.16. Cross-section of Pit Structure 1 as exposed in the arroyo.

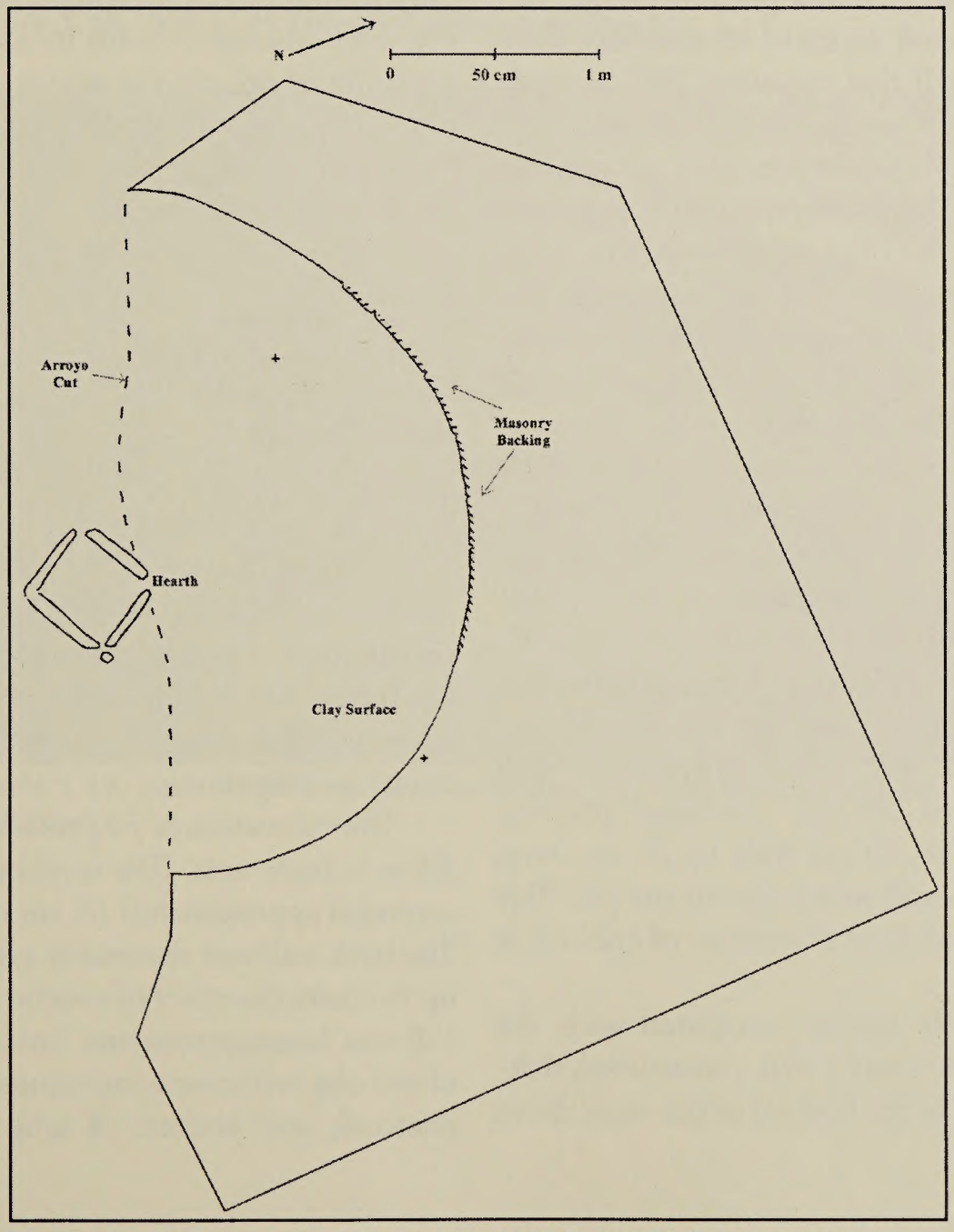


Figure 3.17. Plan map of Excavation Unit B and Pit Structure 1.

structure and accounts for the lower 30 cm of fill. Level 1 fill consisted of massive orange structural clay with chunks of charcoal and rock. A large amount of medium-sized rock lay directly on the floor and was concentrated on the southeast side. It may have been part of the above-ground superstructure.

Floor. The maximum diameter of Pit Structure 1 was 3 m. The floor surface was a well prepared and smoothed orange clay ranging from 1 to 4 cm thick (Figs. 3.18, 3.19). The floor clay was similar to the overlying structural fill. The floor surface was stained brown, but had virtually no accumulation of use deposits. Neither was there blow sand, or other evidence of non-use prior to the structure's collapse. A probe of the floor revealed a dense, purple, Petrified Forest Member of the Chinle clay deposit (Stratum 4).

Walls. The walls of the structure were vertical, rising abruptly from the floor. They were cut into the firm consolidated clay of Stratum 3. Plaster adhered to the walls to a point at about 60 cm above the floor. Two applications of plaster were apparent. An exception to the plastered portion of the wall was a well constructed segment of masonry flush against the north wall that measured 190 cm wide by a maximum of 120 cm high. This "wainscoting" consisted of 7 upright sandstone slabs set into the floor (Fig. 3.19). The slabs varied in height and had up to three courses of mortared masonry above them that leveled the work. The adjacent walls were plastered flush with the masonry. Above the rock lay a massive fill of pink clay about 25 cm thick. Above the pink clay, and about 85 cm above the floor, was a one-meter-long lens of charcoal, 10 cm thick, exposed in Stratum 3 by the prehistoric excavation of the pit structure. A similar lens of charcoal was truncated by the pit on its east edge. In light of the Archaic features (F12/34) a few meters to the north, it is probable that these charcoal deposits represent a discontinuous Archaic horizon (see Chapter 5).

Pit Structure 1 was fully subterranean with a minimum depth of 170 cm. Remnant portions of an encircling ledge, 20 cm wide by 20 cm deep, occurred on the east and west edges of the pit. This ledge could have facilitated placement of cribbed or flat roof beams.

Hearth. The sole feature associated with the floor of Pit Structure 1 was a well-constructed, slab-lined hearth located in the bottom of the wash about 20 cm from the edge of the floor itself (Fig. 3.20). Constructed of four large slabs, it is nearly square, measuring 48 cm x 50 cm x 25 cm deep. The slabs are 3 to 6 cm thick and are sloped slightly inward. Upper fill of the hearth is gravel and large rock recently deposited by the wash. Lower fill was 18 cm of gray ash with small diameter charcoal fragments. A small clay ball was found in the lower ash. A large macrobotanical sample yielded the highest seed diversity and density values on site (see Chapter 8, Table 8.3).

Floor Contact Artifacts. A wide range of artifacts were found in floor contact with Pit Structure 1, suggesting that a variety of common tasks were carried out in it. Stone artifacts in floor contact included: mano fragments (6), cobble edge abraders (2), a utilized flake (1), a core shatter flake (1) and a sphere (see Chapter 7 Provenience Chart) The ceramic assemblage consisted of several dozen, locally made, late Pueblo II corrugated sherds, local redward, and various whitewares. The most temporally sensitive sherd was a single worked polychrome sherd (see Chapter 6, Table 6.7 and also Fig. 6.6). Modified sherds included 2 ceramic disks, a spindle whorl, and the worked sherd (Figs. 6.5 and 6.6). A large triangular bone awl and an unmodified Artiodactyla long bone completes the floor contact assemblage.

Feature 4

Feature 4 niche/tunnel remnant. Feature 4 was initially visible in the bank of the arroyo south of Pit Structure 1 (Figs. 3.1, 3.2) as an oval shaped pocket of fill measuring 100 cm wide by 60 cm high. It originated just below the top of the Stratum 3 horizon. A large, finely dressed, rectangular sandstone slab, and a concentration of restorable bowl sherds were visible in the profile (Fig. 3.21, 6.1D). On the extreme south edge was the impression of an apparent ceramic vessel that had been removed prior to our investigations.

The excavation of F4 proceeded by removing the fill as a single unit. The resulting niche-like feature extended approximately 65 cm into the arroyo bank. The back wall was reasonably symmetrical, rounding up to create the effect of a niche rather than a tunnel. Fill was homogenous and "midden-like" consisting of red clay with some inclusions of tiny rock, a little charcoal, and pockets of ashy midden - possibly

Figure 3.18. View of Pit Structure 1, facing northeast

Figure 3.19. Detail of Pit Structure 1 northeast wall with masonry and ash lens above.

Figure 3.20. Detail of Pit Structure 1 Hearth, partially excavated.

originating in Stratum 2.

The dressed slab extended to the extreme interior end of the feature. It measured 63 cm x 48 cm x 2 cm thick. This type of dressed slab is typically used as a "door" closure (Fig. 3.21). Several small, flat, burned juniper branches lay directly under the rock along with a few sherds, a stone sphere, and talc disk. Removal of the slab revealed a large, plain gray, vessel panel with an artiodactyla metapodial long bone beneath it. Also present was a restorable North Creek Black-on-gray bowl and a Hildale Black-on-gray bowl (Fig. 3.22, 6.2).

Low Ash Stratum

Two areas with lenses of ash within Stratum 3 were exposed in Excavation Unit B. Both are located within Stratum 3 and were truncated by Pit Structure 1. They are believed to be associated with the F21/F34 "pithouse" which was radiocarbon dated to the Late Archaic Period (see Chapter 5).

Attempts at defining the northeast wall of Pit Structure 1 exposed an ash stratum directly above the masonry "wainscoting" (Fig. 3.19). The exposure was about 1 meter long by 10 cm thick and was 70-80 cm above the floor of the pit structure. It is possible that the masonry was an attempt to reinforce loose fill in this area.

The second charcoal lens of potential Archaic age was exposed in the arroyo wall and was truncated by the prehistoric excavation of Pit Structure 1 on the southeast side (Fig. 3.16).

Excavation Unit B, Description Summary

Excavation of Unit B exposed Pit Structure 1 and a poorly defined surrounding surface that originates on, or just above, Stratum 3. Its relationship with Excavation Unit A is established by the Stratum 2 deposits in the east wall of the arroyo, which are continuous from just south of the room block (Fig. 3.12) and overlie Pit Structure 1 - although the continuity of the profile was disrupted by a wash event that removed a portion of Stratum 2 above the northwest corner of the structure (Fig. 3.16).

Macrofloral and Pollen Analysis. A large macrobotanical sample collected from the hearth of Pit Structure 1 yielded the highest seed diversity and density values for the site. Seeds included a large quantity of *Chenopodium* sp., a single *Phaseolus vulgaris* fragment, *Zea mays*, ground cherry and soapweed (see Chapter 10, Table 10.3)

Pollen analysis from the floor of Pit Structure 1 included several economic types including *Zea mays*, *Cylindropuntia*, Apiaceae, and Poaceae (See Chapter 11).

Dating. A radiocarbon assay of the medium-sized charcoal inclusions in the lower structural fill of Pit Structure 1 produced a conventional radiocarbon age of A.D.1020+/- 50 (Beta- 77113). This date was considered too early in view of the polychrome worked sherd found in floor contact. A second date, run on large charcoal from the hearth produced an identical date (Beta-66334). These dates are attributed to reuse of "old wood." No explanation is

Figure 3.21. Pre-excavation view of Feature 4, note restorable vessel (Fig. 6.1D) and dressed door slab (Fig. 8.4).

Figure 3.22. Feature 4 niche/tunnel with in situ vessels FS-163, and FS-169 (See Fig 6.1:B, F).

offered as to why they are identical.

Two additional dates were run on *Zea mays* to overcome the apparent old wood problem: 1) a corncob from Level 2 fill produced a radiocarbon age of 870+/-80 BP (Beta 100262); 2) a corn kernel from the hearth yielded a conventional age of 800+/-30 BP (Beta 117940) with a 2 sigma calibrated range of AD 1205-1280.

The Feature 4 niche/tunnel occurs on the west side of the arroyo and is entirely cut off from Pit Structure 1. It could be an appurtenance to Pit Structure 1, although this is not possible to demonstrate. It was not dated but ceramics are obviously late Pueblo II. The feature occurs entirely within Stratum 3.

Feature 4 is an isolated remnant of a tunnel-like niche or possible vent shaft. It is possible that a portion of it formed a vertical shaft that originated at an unidentified occupational surface subsequently covered by Stratum 2 deposit. Although it could not be positively associated with the remains of Pit Structure 1 exposed in the opposite bank, horizontally it lies only a meter or so from the projected arc of that structure. Vertically, the feature lies at the same level as the encircling shelf noted for Pit Structure 1 (Fig. 3.2c).

Provenience	Depth	Material	Object	Count
F3	fill	sherd	perforated disk fragment	1
F3 fill	fill	bone	unmodified	10
F3 fill	fill	organic	corn cob	1
F3 fill	fill	sherd	all types	198
F3 fill	fill	sherd	clay object	5
F3 fill	fill	stone	utilized flake	10
F3 fill	fill	stone	flake	26
F3 fill	fill	stone	core scraper	2
F3 fill	fill	stone	cobble scraper	1
F3 fill	fill	stone	edge grinder	2
F3 fill	fill	stone	groundstone object	12
F3 fill	fill	stone	sandstone object	7
F3 fill	fill	stone	petrified wood object	1
F3 Grid F-16 fill	100-120cm	bone	unmodified	2
F3 Grid F-16 fill	100-120cm	sherd	all types	122
F3 Grid F-16 fill	100-120cm	sherd	handle	1
F3 Grid F-16 fill	100-120cm	stone	biface	1
F3 Grid F-16 fill	100-120cm	stone	utilized flake	4
F3 Grid F-16 fill	100-120cm	stone	flake	6
F3 Grid F-16 fill	100-120cm	stone	core scraper	3
F3 Grid F-16 fill	100-120cm	stone	groundstone object	1
F3 E-18 fill	120-140cm	sherd	all types	280
F3 E-18 fill	120-140cm	sherd	handle fragment	1
F3 E-18 fill	120-140cm	sherd	clay object	1
F3 E-18 fill	120-140cm	stone	utilized flake	3
F3 E-18 fill	120-140cm	stone	flake	11
F3 E-18 fill	120-140cm	stone	core scraper	4
F3 E-18 fill	120-140cm	stone	cobble scraper	1
F3 E-18 fill	120-140cm	stone	groundstone object	8
F3 E-18 fill	120-140cm	stone	sandstone object	6
F3 E-18 fill	120-140cm	stone	petrified wood object	1
F3 fill	120-140cm	bone	unmodified	4
F3 fill	120-140cm	bone	unmodified	1
F3 fill	120-140cm	sherd	all types	258
F3 fill	120-140cm	sherd	disk	1
F3 fill	120-140cm	sherd	ladle handle	1
F3 fill	120-140cm	sherd	all types	314
F3 fill	120-140cm	sherd	disk	1
F3 fill	120-140cm	sherd	handle fragment	2
F3 fill	120-140cm	sherd	all types	91
F3 fill	120-140cm	sherd	all types	155
F3 fill	120-140cm	sherd	all types	114
F3 fill	120-140cm	stone	biface fragment	1
F3 fill	120-140cm	stone	utilized flake	3
F3 fill	120-140cm	stone	flake	4
F3 fill	120-140cm	stone	groundstone object	2
F3 fill	120-140cm	stone	point fragment	2
F3 fill	120-140cm	stone	bifacially modified	1
F3 fill	120-140cm	stone	flake	38
F3 fill	120-140cm	stone	utilized flake	4
F3 fill	120-140cm	stone	abrading stone	1

Table 3.1. Pit Structure 1 Artifact Catalog

F3 fill	120-140cm	stone	edge pounder	1
F3 fill	120-140cm	stone	groundstone disk	1
F3 fill	120-140cm	stone	groundstone object	2
F3 fill	120-140cm	stone	flake	9
F3 fill	120-140cm	stone	edge pounder	1
F3 fill	120-140cm	stone	mano fragment	1
F3 fill	120-140cm	stone	groundstone disk	1
F3 fill	120-140cm	stone	groundstone object	1
F3 fill	120-140cm	stone	flake	8
F3 fill	120-140cm	stone	eore fragment	1
F3 fill	120-140cm	stone	flake	5
F3 fill	140-160cm	sherd	all types	181
F3 fill	140-160cm	sherd	modified	1
F3 fill	140-160cm	sherd	all types	171
F3 fill	140-160cm	sherd	handle fragment	2
F3 fill	140-160cm	stone	bifaeially modified	1
F3 fill	140-160cm	stone	flake	4
F3 fill	140-160cm	stone	edge grinder	2
F3 fill	140-160cm	stone	groundstone object	11
F3 fill	140-160cm	stone	scraper	1
F3 fill	140-160cm	stone	flake	16
F3 fill	140-160cm	stone	groundstone object	2
F3 fill	160-180cm	bone	unmodified fragment	2
F3 fill	160-180cm	sherd	all types	82
F3 fill	160-180cm	sherd	handle fragment	1
F3 fill	160-180cm	sherd	perforated disk	1
F3 fill	160-180cm	sherd	disk	1
F3 fill	160-180cm	sherd	handle fragment	1
F3 fill	160-180cm	sherd	modified	1
F3 fill	160-180cm	sherd	unfired elay	2
F3 fill	160-180cm	sherd	all types	217
F3 fill	160-180cm	stone	point fragment	1
F3 fill	160-180cm	stone	unifacially modified	1
F3 fill	160-180cm	stone	utilized flake	1
F3 fill	160-180cm	stone	edge pounder	3
F3 fill	160-180cm	stone	core shatter	1
F3 fill	160-180cm	stone	eore remnant	1
F3 fill	160-180cm	stone	groundstone object	1
F3 fill	160-180cm	stone	sandstone concretion	1
F3 fill	160-180cm	stone	scraper	1
F3 fill	160-180cm	stone	utilized flake	1
F3 fill	160-180cm	stone	flake	24
F3 fill	160-180cm	stone	edge pounder	1
F3 fill	160-180cm	stone	groundstone object	4
F3 fill	160-180cm	stone	sandstone object	1
F3 fill	180-200cm	organic	eorn eob	1
F3 fill	180-200cm	sherd	all types	117
F3 fill	180-200cm	sherd	disk	1
F3 fill	180-200cm	sherd	handle	1
F3 fill	180-200cm	sherd	clay eoil	1
F3 fill	180-200cm	sherd	all types	78
F3 fill	180-200cm	stone	utilized flake	2

Table 3.1 (continued). Pit Structure 1 Artifact Catalog

F3 fill	180-200cm	stone	flake	9
F3 fill	180-200cm	stone	core scraper	1
F3 fill	180-200cm	stone	cobble scraper	1
F3 fill	180-200cm	stone	groundstone object	4
F3 fill	180-200cm	stone	biface preform	1
F3 fill	180-200cm	stone	flake	11
F3 fill	180-200cm	stone	edge grinder	1
F3 fill	180-200cm	stone	groundstone object	2
F3 fill	200-220cm	organic	corn cob	1
F3 fill	200-220cm	sherd	all types	201
F3 fill	200-220cm	stone	utilized flake	1
F3 fill	200-220cm	stone	flake	32
F3 fill	200-220cm	stone	cobble scraper	1
F3 fill	200-220cm	stone	edge grinder	3
F3 fill	200-220cm	stone	edge pounder	2
F3 fill	200-220cm	stone	mano fragment	1
F3 fill	200-220cm	stone	groundstone object	2
F3 fill	200-220cm	stone	gypsum	2
F3 fill	220-240cm	sherd	all types	75
F3 fill	220-240cm	sherd	disk	1
F3 fill	220-240cm	stone	flake	7
F3 fill	220-240cm	stone	core	3
F3 fill	220-240cm	stone	hammerstone	2
F3 fill	220-240cm	stone	chopper	1
F3 fill	220-240cm	stone	groundstone disk	1
F3 fill	220-240cm	stone	groundstone fragment	1
F3 fill	220-240cm	stone	mano fragment	1
F3 fill	220-240cm	stone	lead fragments	6
F3 fill west side	220cm	sherd	corrugated	2
F3 fill west side	220cm	stone	edge pounder	3
F3 fill	240-260cm	sherd	all types	44
F3 fill	240-260cm	stone	flake	10
F3 fill	240-260cm	stone	hammerstone	1
F3 fill	240-260cm	stone	metate fragment	1
F3 fill	240-260cm	stone	groundstone object	1
F3 fill	above floor 30-50cm	sherd	all types	36
F3 fill	above floor 30-50cm	sherd	modified	1
F3 fill	above floor 30-50cm	stone	mano	4
F3 fill	above floor 30-50cm	stone	flake	3
F3 fill	30-10cm above floor	sherd	all types	48
F3 fill	30-10cm above floor	sherd	modified	1
F3 fill	30-10cm above floor	stone	flake	4
F3 fill	30-10cm above floor	stone	core	2
F3 fill	30-10cm above floor	stone	edge pounder	3
F3 floor contact	contact to 10cm	bone	unmodified	1

Table 3.1 (continued). Pit Structure 1 Artifact Catalog

F3 floor contact	contact to 10cm	sherd	all types	63
F3 floor contact	contact to 10cm	stone	flake	1
F3 floor contact	contact to 10cm	stone	core	1
F3 floor contact	contact to 10cm	stone	edge pounder	3
F3 floor contact	contact to 10cm	stone	hammerstone	2
F3 floor contact	contact to 10cm	stone	mano fragment	2
F3	floor contact	sherd	all types	6
F3	floor contact	sherd	all types	11
F3	floor contact	sherd	disk	1
F3	floor contact	sherd	disk fragment	1
F3	floor contact	sherd	modified	2
F3	floor contact	stone	groundstone fragment	
F3	pithouse floor contact	sherd	all types	12
F3	pithouse floor contact	sherd	disk	1
F3	spoil	sherd	all types	146
F3	spoil	sherd	all types	70
F3	spoil	sherd	modified	1
F3	spoil	sherd	all types	23
F3	spoil	stone	knife	1
F3	spoil	stone	edge grinder	1
F3	spoil	stone	hammerstone	1
F3	spoil	stone	mano fragment	1
F3	spoil	stone	utilized flake	1
F3	spoil	stone	abrading stone fragment	1
F3	spoil	stone	mano fragment	1
F3	spoil	stone	groundstone object	1
F3	spoil	stone	polishing stone fragment	1
F3	spoil	stone	groundstone object	1
F3	spoil near floor	sherd	all types	31
F3	spoil near floor	sherd	modified	1
F3	spoil near floor	stone	biface fragment	1
F3	spoil near floor	stone	utilized flake	1
F3	spoil near floor	stone	flake	1
F3	spoil near floor	stone	cobble scraper	1
F3	spoil near floor	stone	mano	1
F3	spoil near floor	stone	sandstone disk	1

Table 3.1 (continued). Pit Structure 1 Artifact Catalog

Excavation Unit C

Unit C lies on the west side of the arroyo cut about 4 meters south of Unit B. It is a triangular excavation unit intended to define in plan the remnants of a small trash-filled structure, eventually designated Pit Structure 3, and an adjacent occupational surface (F40) exposed in the bank of the arroyo (Figs. 3.1, 3.2). Eventually, a second miniature subterranean room nearly identical to Pit Structure 3, designated Pit Structure 4, was also defined and excavated. The excavation unit encompassed an area of approximately 17 square meters (Figs. 3.23 & 3.24).

Excavation of the unit proceeded by quickly skim shoveling approximately 80 cm of Stratum 1 overburden, an essentially sterile deposit, which overlaid the entire excavation unit (Fig. 3.25 & 3.26). Up to 50 cm of the Stratum 2 cultural unit also sealed the entire excavation unit. Stratum 2 was consistently dark brown and midden-like throughout. Charcoal, rodent, scrap and modified bone, ceramics, and stone tools were common in the deposit. Fill underlying Stratum 2, and lying on and over an occupational surface designated F40, appeared to be mounded structural debris. This debris was eventually associated with Pit Structures 3 and 4.

Pit Structure 3

The encircling "bench" of Pit Structure 3 was exposed at 130 cm below the modern surface (Figs. 3.27, 3.28). Abundant small sandstone fragments, masses of clay, charcoal, timber fragments, and burned daub lay directly on the bench surface. Upper fill of the pit itself included trash deposits and tabular sandstone. At 141 cm, fragmentary human remains of an infant/juvenile were encountered (See section on human remains). The remains were incomplete, disarticulated, and a burial pit could not be discerned. No artifacts were associated. The remainder of the pit fill was essentially structural clay and some small rock but also a large amount of trash including over 400 sherds, chipped stone, ceramic disks, mano and metate fragments, a bone needle fragment, a biface, a pounding stone, two Parowan Basal-notched projectile points, and a small triangular Cottonwood style point (Table 3.2). An obvious intrusive cut occurs on the west edge immediately above the bench. Here the structure's fill was replaced with laminates of gravel from a post occupational flooding event (Fig. 3.27).

Final definition of Pit Structure 3 delineated a remarkably well preserved, semi-subterranean, structure whose interior pit was little more that 1.5 m in diameter (Fig. 3.28). Overall, the structure was 1 m deep with the pit itself 70 cm deep and the

Figure 3.23. View of Excavation Unit C with Stratum A removed, note F40 surface and PS-3 in profile.

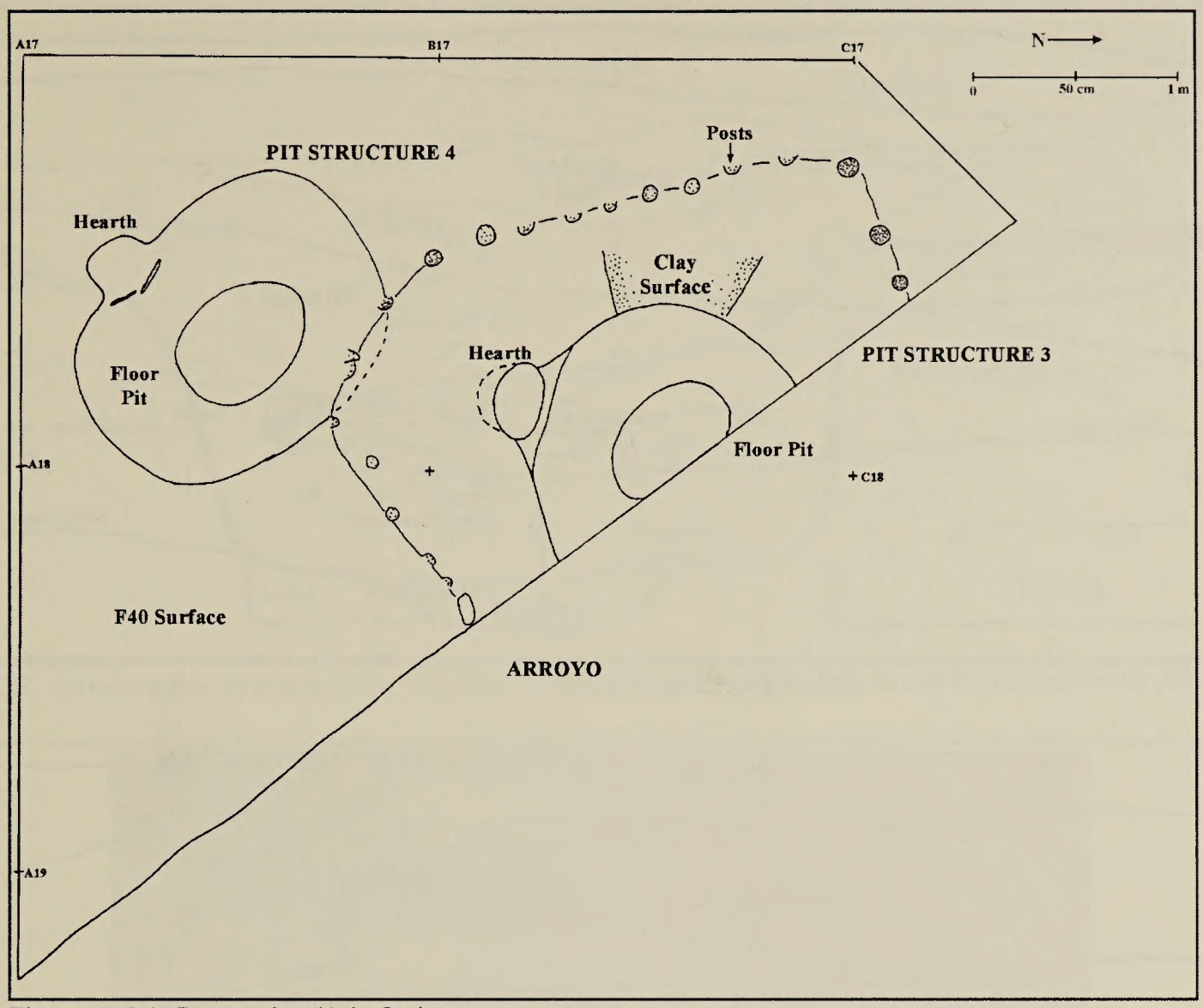


Figure 3.24. Excavation Unit C plan map.

encircling bench averaging about 30 cm deep. The bench ranged in width from 50 cm to 1 m wide. The overall maximum width of the structure is 275 cm.

Walls. Walls of the internal pit were vertical and excavated into the sterile clay of Stratum 3. Upper walls around the perimeter of the bench were constructed of jacal, as evidenced by closely spaced vertical posts and post molds in clay and fired daub. The wall remnants are flat-sided with rounded corners suggesting an irregular quadrilateral, or possibly even pentagonal-shaped, structure. Post remnants averaged 8 cm in diameter and varied in their spacing (Fig. 3.24).

Hearth. Excavated into the south-southwest corner of the lower pit was a clay-coped, fire-hardened "alcove-like" hearth (Fig. 3.24, 3.28). The bottom was a rounded depression of fired clay. The wall above the basin tapered slightly inward towards the top of the pit creating a chimney effect. The oval-shaped, ash-filled basin measured 35 cm x 30 cm and had low clay coping across the front separating it from the floor surface. Seventeen corrugated sherds were recovered from the fill of the hearth.

Sand Filled Bin. On the floor of Pit Structure 3 was the remnant of an oval pit measuring 60 cm by a projected 50 cm wide. The basin was flat bottomed and about 12 cm deep. Fill to the level of the floor was clean, tan sand. The feature was not sealed with clay, as is frequently the case with sand-filled bins in Virgin Anasazi pithouses.

On the surrounding bench was a prepared surface of purple, Petrified Forest Member of the Chinle Formation, clay (Fig.3.24). The surface was fan shaped, measured 75 cm x 50 cm and extended from the edge of the pit towards the wall.

Floor Contact Artifacts. Artifacts in contact with the bench of the structure included: two manos, one mano fragment, one cobble abrader, one flake abrader, and a bone needle. Artifacts on the floor of the pit included: a grinding slab fragment, a flake abrader, a cobble abraders and an edge grinder. In addition to the sherds found in the hearth fill, there were three local plain sherds on the floor.

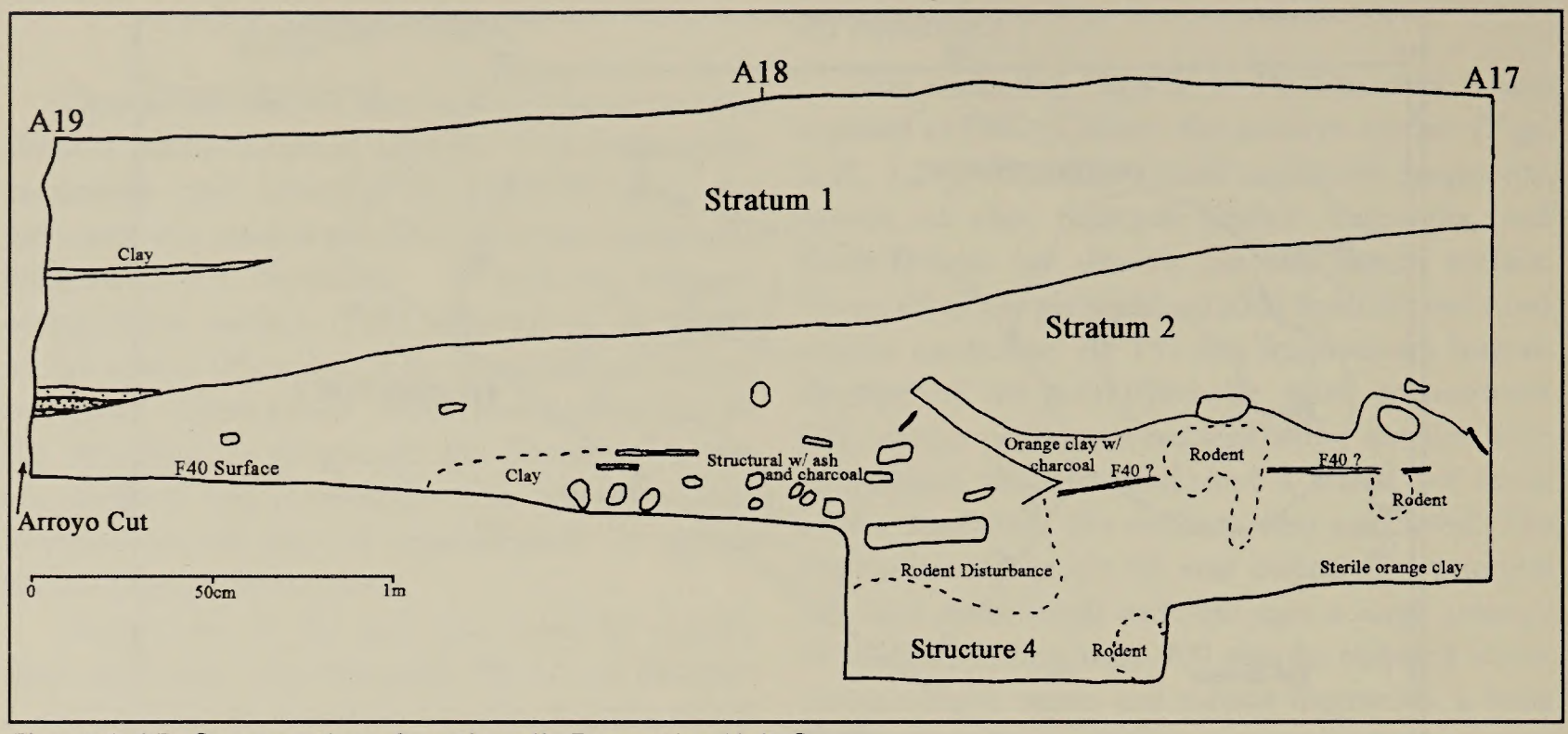


Figure 3.25. Cross-section of south wall, Excavation Unit C

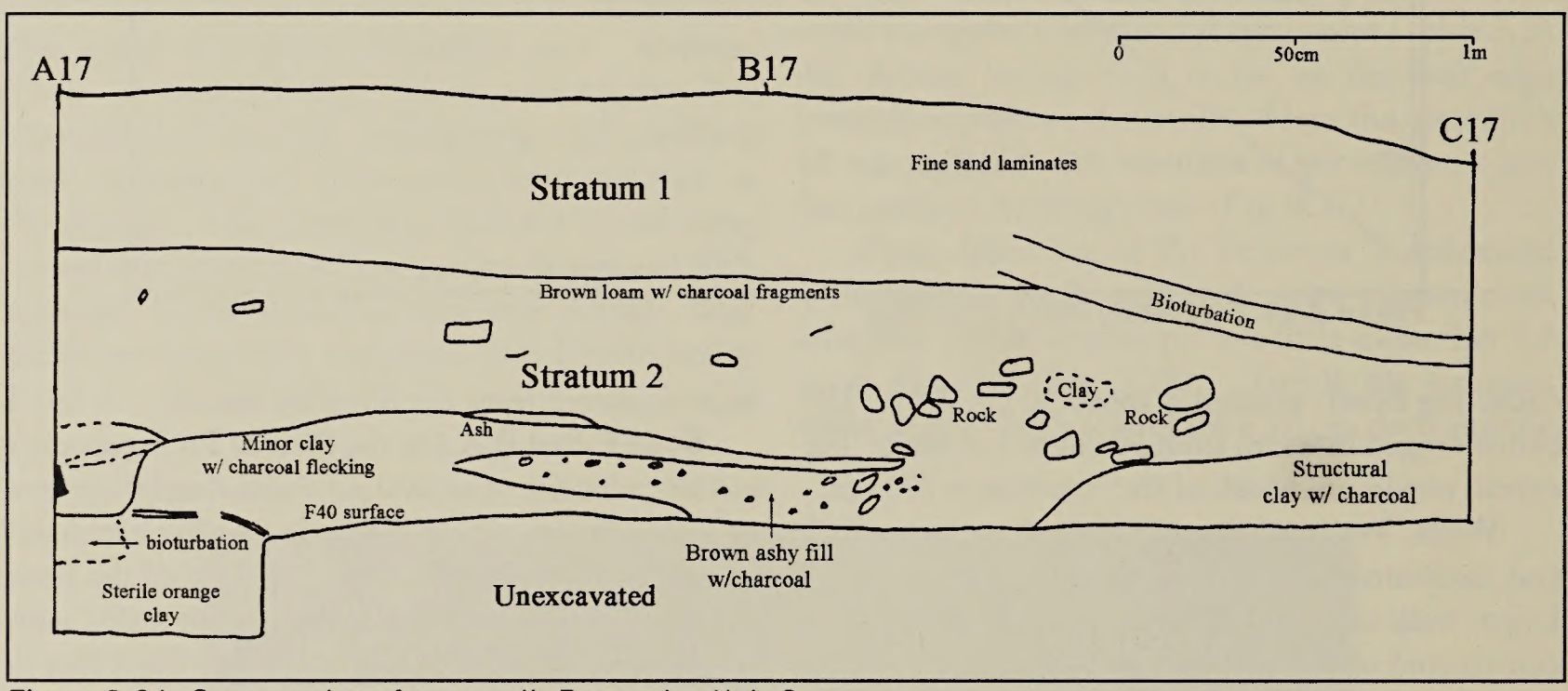


Figure 3.26. Cross-section of west wall, Excavation Unit C.

Pit Structure 4

Pit Structure 4 was encountered after Pit Structure 3 had been defined and excavated. During the course of removing the remaining fill overlying the F40 surface, a soil change indicated the presence of this feature at a depth of 110 cm below the modern surface (Fig. 3.29). As in Pit Structure 3, the upper fill seems to have been mounded above the pit and beyond, extending out over the F40 surface (Figs. 3.25, 3.26, 3.29). This upper fill consisted of structural clay and large rock, as well as midden deposit containing sherds, animal bone, and a few human bones (a young adult femur as well as partial infant remains.) The deposits were disturbed by rodents and possibly prehistoric human activity.

Fill. The upper 30–40 cm of fill in the pit structure itself consisted primarily of midden deposits with artifacts, ash, and clay extremely disturbed by rodent activity. At 40 cm below the surrounding F40 surface a compacted reddish-orange, structural, but unburned clay was encountered. The lower 35–40 cm fill of this structural unit, lying directly over the floor, consisted of a more friable sandy clay with small charcoal fragment inclusions. Several grapefruit-sized sandstone rocks lay in this lower deposit.

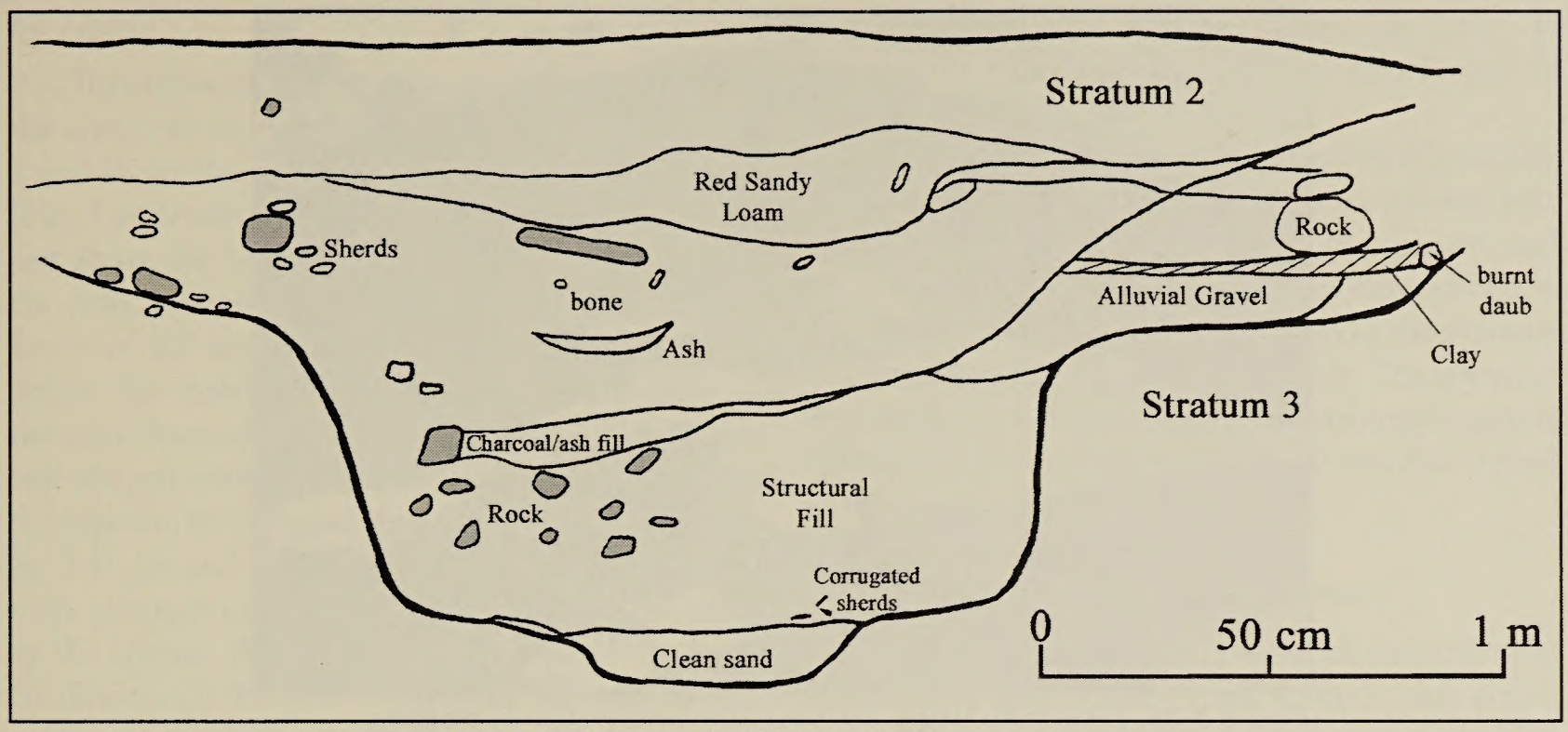


Figure 3.27. Cross-section drawing of Pit Structure 3 fill exposed in arroyo cut.

Figure 3.28. Final definition of Pit Structure 3.

Floor. The floor of Pit Structure 4 lay 75 cm below the F40 surface (Fig. 3.30). It was easily defined and had several centimeters of a dirty brown, loose, sandy deposit overlying it. The floor itself was a hard, nearly polished, surface cut into Stratum 3 that gently sloped upward to meet the wall.

Walls. The walls were vertical and extended 75 cm to the F40 surface. Plaster was visible to a point about 35 cm above the floor. Rodent disturbance in the vicinity of the hearth limited the plaster to about 10 cm above the floor. No bench or perimeter wall, as found in Pit Structure 3, was encountered.

Hearth. An "alcove-style" hearth, similar in size, location, and style to the Pit Structure 3 hearth is located in the south-southwest corner of the structure. Bulbous shaped, its backside protrudes slightly beyond the perimeter of the pit. The interior edge consists of two thin sandstone slabs set into the floor. The upper portion was partially damaged by rodents. The base of the hearth measured 30 cm in diameter. A small amount of fine white ash lay on the fire burned and hardened floor.

Floor Pit. Similar to the floor pit in Pit Structure 3, this feature is an oval, sand-filled pit located in the center of the structure. It measures 70 cm x 50 cm and 10 cm deep with a smooth clay floor. Fill was

Figure 3.29. Excavation Unit C, Pit Structure 4 excavation in progress.

Figure 3.30. Final definition of Pit Structure 4, Pit Structure 3 and F40 surface.

a clean, coarse, purplish sand – apparently of Chinle origin, that was level with the top of the pit. Two sandstone slabs occurred in the fill of the pit. Similar to Pit Structure 3, the bin was not sealed with clay.

Feature 40 Surface

Excavation Unit C profiles A19-A17 and A17-C17 (Figs. 3.25, 3.26) show an extensive occupation surface, designated F40, that lies directly on Stratum 3 and spans the entire unit (Fig. 3.30). Both Pit Structures 3 and 4 are cut through this surface. F40 is well defined within the excavation unit and appears to continue to the north and west beyond the limits of the excavated area. Massive amounts of structural clay, rock, charcoal, ash, and sand – much of it disturbed by rodents and roots, lay directly on the surface. Most, or all, of this structural debris is apparently associated with Pit Structures 3 and 4. Note that the A19-A17 profile (Fig. 3.25) also depicts a discontinuous use-surface, overlying Pit Structure 4, that could have been associated with Pit Structure 3.

F6 Hearth

This isolated feature occurs on the east side of the arroyo about 4 meters southeast of Pit Structure 1 and about the same distance from Pit Structure 3 (Fig. 3.1). It was initially defined as a pit originating just above the base of Stratum 2 and extending 70 cm into Stratum 3 (Figs. 3.31, 3.32). A vertical block of fill about 20 cm thick was removed to define the interior shape of the pit. The floor of the pit is burned and spherical but rapidly becomes bell-shaped with a maximum width of 35 cm. On the interior, to the northeast, the floor surface slopes up 5-6 cm and is ashy and burnt. If the pit was truly symmetrical, only about 5 cm was cut away by the arroyo. A fine white ash deposit, 6 cm deep, lay directly on the floor. Above the ash were several artifacts, including a partially restorable corrugated vessel, a large quartzite flake, and a sandstone slab fragment. The lower 40 or 50 cm of fill, towards the interior of the pit, appeared to be red structural clay. Overlying this clay was a very dark brown deposit of apparent Stratum 2 fill with abundant charcoal, some rock, and several corrugated sherds.

Overlying the F6 hearth, near or at the base of Stratum 2, is a slightly dish-shaped soil contact, defined in part by a thin lens of caliche and overlaid by rock, ash, and thin bands of clay that extend over an area about 2.5 meters wide (Fig. 3.31). It is probable that this deposit is structural and is associated with the hearth.

The profile of the F6 hearth is remarkably similar to the "alcove" hearths, located on the southwest side of Pit Structures 3 and 4. Fill of the feature, and the interior shape, insofar as could be determined, is also consistent with its interpretation as the extreme southwestern edge of an alcove hearth. The apparent structural fill overlying the feature strongly suggests that a nearly complete pit structure remains buried to the northeast.

Excavation Unit C, Descriptive Summary

Excavation Unit C held two small pit structures designated Pit Structures 3 and 4. Both were sealed under Stratum 2 deposits and originated on the F40 occupational surface. The bench of Pit Structure 3 overlaid the pit of Pit Structure-4 indicating that the structures were sequentially occupied. Deposits of structural debris, midden, and abundant artifacts lying above these structures in the Unit C fill suggest that they were used as dumps after they were abandoned.

The Feature 6 hearth, although visible only in profile, describes very well as a third "mini" pit structure. These structures are remarkably similar in

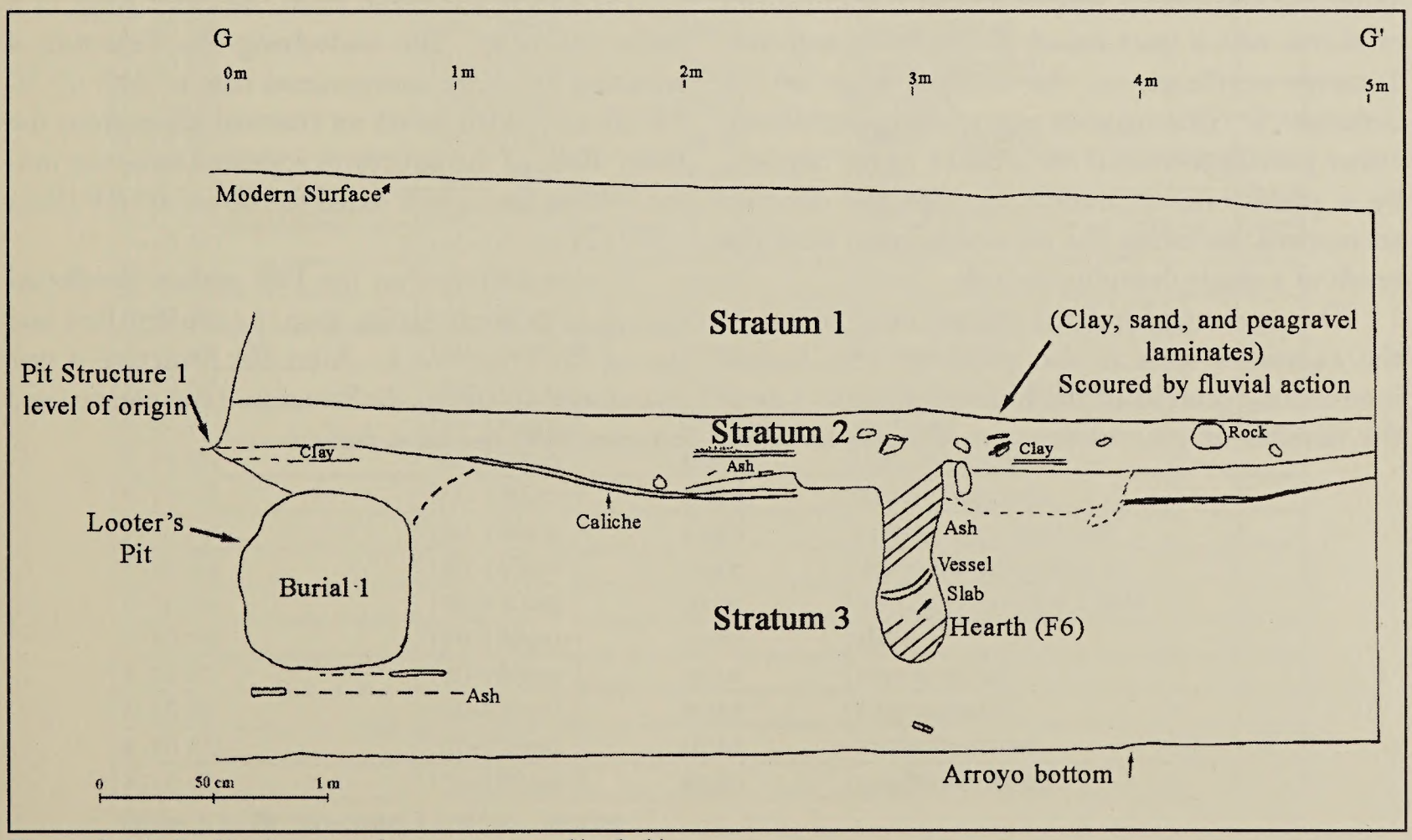


Figure 3.31. Profile drawing of arroyo cut profile G-G'.

Figure 3.32. Detail view of F6 Hearth, partially excavated.

size and layout. Each held a variety of domestic tools suggesting they functioned as domiciles, probably in the winter, but for a very limited number of people.

Scattered sherds from reconstructable vessels have the potential to inform us about the nature of the depositional processes involved in the formation of pit structure fill. A single example was recognized in Excavation Unit C. An individual sherd from a partially restorable Orderville Black-on-white bowl (Fig. 6.2c), found in the upper midden/structural fill above the F40 surface, was refitted with the majority of sherds which were found 30 cm lower, and over 1 meter northeast, on the extreme edge of Pit Structure 3. This suggests one of two possibilities: either post-depositional disturbance of the deposits by a prehistoric excavation, or that the deposits themselves, including the restorable bowl, were the result of a single dumping episode.

The amount of isolated human bone found in the excavation unit is also puzzling. No formal interments occurred in the excavation unit. Given the number of pit structures on the site however, and assuming a long-term but episodic occupation, the scattered human remains could have been the result of inadvertent exhumations during the course of excavating new pit structures.

Dating. Three dates were obtained from the features in Excavation Unit C: all three complement and support the excavation data. Both Pit Structures 3 and 4 were excavated into the F40 occupation surface. The upper most structure, Pit Structure 3, yielded a conventional date of 700 +/- 50 BP Beta-77115) which was taken from the outer rings of a perimeter post. The underlying Pit Structure 4 structure yielded a conventional date of 840 +/- 50 BP (Beta-77116) based on charcoal taken from the floor. Both of the structures appeared to be cut into the F40 surface which dated to 760 +/- 60 BP (Beta - 77112).

It seems likely that the F40 surface developed during, or possibly earlier, than the construction and use of Pit Structure 4. After Pit Structure 4 was abandoned and filled, Pit Structure 3 was constructed on essentially the same surface.

Provenience	Depth	Material	Object	Count
F-10 bench fill	---	clay	unfired clay-daub	2
F-10 bench fill	---	sherd	disk	1
F-10 bench fill	---	sherd	handle	1
F-10 bench fill	---	sherd	all types	21
F-10 bench fill	---	stone	abrading stone	1
F-10 bench fill	---	stone	flake	3
F-10 bench fill	---	stone	groundstone object	1
F-10 bench contact	---	sherd	redware	1
F-10 bench contact	---	stone	edge pounder	2
F-10 bench contact	---	stone	mano	1
F-10 bench contact	---	stone	mano fragment	1
F-10 clean-up around bench	---	sherd	all types	13
F-10 clean-up around bench	---	stone	bifacially modified flake	1
F-10 fill over bench	---	sherd	all types	23
F-10 fill over bench	---	stone	mano fragment	1
F-10 bench floor contact	---	stone	mano	1
F-10 fill	---	sherd	all types	5
F-10 fill	---	sherd	disk fragment	1
F-10 fill	---	sherd	unfired clay fragment	1
F-10 fill	---	stone	groundstone fragment	1
F-10 fill	100-120cm	sherd	all types	202
F-10 fill	100-120cm	sherd	modified	1
F-10 fill	100-120cm	sherd	handle fragment	1
F-10 fill	100-120cm	stone	projectile point	1
F-10 fill	100-120cm	stone	biface fragment	1
F-10 fill	100-120cm	stone	flakes	21
F-10 fill	100-120cm	stone	modified sandstone	2
F-10 fill	100-120cm	stone	hammerstone	1
F-10 fill	100-120cm	stone	mano fragment	2
F-10 fill	120-140cm	sherd	all types	77
F-10 fill	120-140cm	stone	biface fragment	1
F-10 fill	120-140cm	stone	flake	10
F-10 fill	120-140cm	stone	edge pounder	1
F-10 fill	140-160cm	sherd	all types	37
F-10 fill	140-160cm	stone	flake	5
F-10 fill	140-160cm	stone	edge pounder	1
F-10 fill	140-160cm	stone	groundstone	1
F-10 fill	160-180cm	bone	unmodified fragment	1
F-10 fill	160-180cm	sherd	all types	127
F-10 fill	160-180cm	sherd	disk fragment	1
F-10 fill	160-180cm	sherd	handle fragment	1
F-10 fill	160-180cm	sherd	unfired clay fragment	2
F-10 fill	160-180cm	stone	triangular projectile pt	1
F-10 fill	160-180cm	stone	bifacially modified flake	2
F-10 fill	160-180cm	stone	flake	23
F-10 fill	160-180cm	stone	core remnant	1
F-10 fill	160-180cm	stone	edge pounder	1
F-10 fill	160-180cm	stone	mano fragment	1
F-10 fill	160-180cm	stone	sandstone object	2

Table 3.2. Pit Structure 3 Artifact Catalog

F-10 fill	160-180cm	stone	groundstone fragment	2
F-10 fill	180-200cm	sherd	all types	55
F-10 fill	180-200cm	stone	flake	12
F-10 fill	180-200cm	stone	mano fragment	1
F-10 fill	180-200cm	stone	metate fragment	1
F-10	5-10cm above floor	sherd	all types	20
F-10	5-10cm above floor	stone	flake	2
F-10	fill	bone	unmodified	3
F-10	fill	sherd	all types	38
F-10	fill	stone	biface fragment	1
F-10	fill	stone	utilized flake	1
F-10	fill	stone	flake	4
F-10	fill	stone	core scraper	1
F-10	fill	stone	mano fragment	1
F-10	spoil	sherd	all types	6
F-10	spoil	stone	flake	1

Table 3.2 (continued). Pit Structure 3 Artifact Catalog

Provenience	Depth	Material	Object	Count
F-20	---	sherd	all types	7
F-20	---	stone	flake	1
F-20	---	stone	groundstone fragment	2
F-20 fill, top of definition at 100cm?	---	sherd	all types	108
F-20 fill, top of definition at 100cm?	---	sherd	modified	2
F-20 fill, top of definition at 100cm?	---	sherd	unfired clay fragment	1
F-20 fill, top of definition at 100cm?	---	stone	biface	1
F-20 fill, top of definition at 100cm?	---	stone	biface fragment	1
F-20 fill, top of definition at 100cm?	---	stone	flake	19
F-20 fill, top of definition at 100cm?	---	stone	edge pounder	2
F-20 fill, top of definition at 100cm?	---	stone	chopper	1
F-20 fill, top of definition at 100cm?	---	stone	mano fragment	1
F-20 fill, top of definition at 100cm?	---	stone	groundstone fragment	1
F-20 fill, top of definition at 100cm?	---	bone	unmodified fragment	4
F-20 fill	---	sherd	all types	13
F-20 fill	---	sherd	unfired clay object	1
F-20 fill	---	stone	flake	2
F-20 fill	---	stone	chopper	1
F-20 fill	---	stone	mano fragment	2

Table 3.3. Pit Structure 4 Artifact Catalog

F-20 fill	---	stone	metate fragment	1
F-20 fill	---	stone	groundstone fragment	1
F-20 fill	---	stone	gypsum fragment	1
F-20 fill	---	sherd	all types	48
F-20 fill	---	stone	flake	1
F-20 fill	---	stone	core	2
F-20 fill	---	stone	edge pounder	1
F-20 fill	---	stone	sandstone disk	1
F-20 fill (upper in A and B-17)	100-120cm	sherd	all types	69
F-20 fill (upper in A and B-17)	100-120cm	sherd	disk	2
F-20 fill (upper in A and B-17)	100-120cm	sherd	unfired clay fragment	2
F-20 fill (upper in A and B-17)	100-120cm	stone	flake	3
F-20 fill (upper in A and B-17)	100-120cm	stone	core	2
F-20 fill (upper in A and B-17)	100-120cm	stone	mano fragment	1
F-20 fill	140-160cm	sherd	all types	56
F-20 fill	140-160cm	sherd	disk	1
F-20 fill	140-160cm	stone	flake	1
F-20 fill	140-160cm	stone	core	1
F-20 fill	140-160cm	stone	hammerstone	1
F-20 fill	140-160cm	stone	sandstone disk	1
F-20 fill	140-160cm	stone	groundstone fragment	1
F-20 floor contact	floor	sherd	all types	9
F-20 floor contact	floor	stone	core remnant	1

Table 3.3 (continued). Pit Structure 4 Artifact Catalog

Excavation Unit D

Excavation Unit D is a rectangular unit intended to expose a deep pit structure (Pit Structure 2) visible in profile on the extreme southwest end of the arroyo cut (Figs.3.1, 3.2, 3.33, 3.34). During the course of the excavation a second feature, Burial 2, was encountered (Table 3.5).

The unit encompassed about 8 square meters measuring roughly 4m x 2m. Strata 1 and 2 overburden at this point along the arroyo was over one meter deep. Because of the difficultly estimating

Figure 3.33. View of Excavation Unit D, removing Stratum 1.

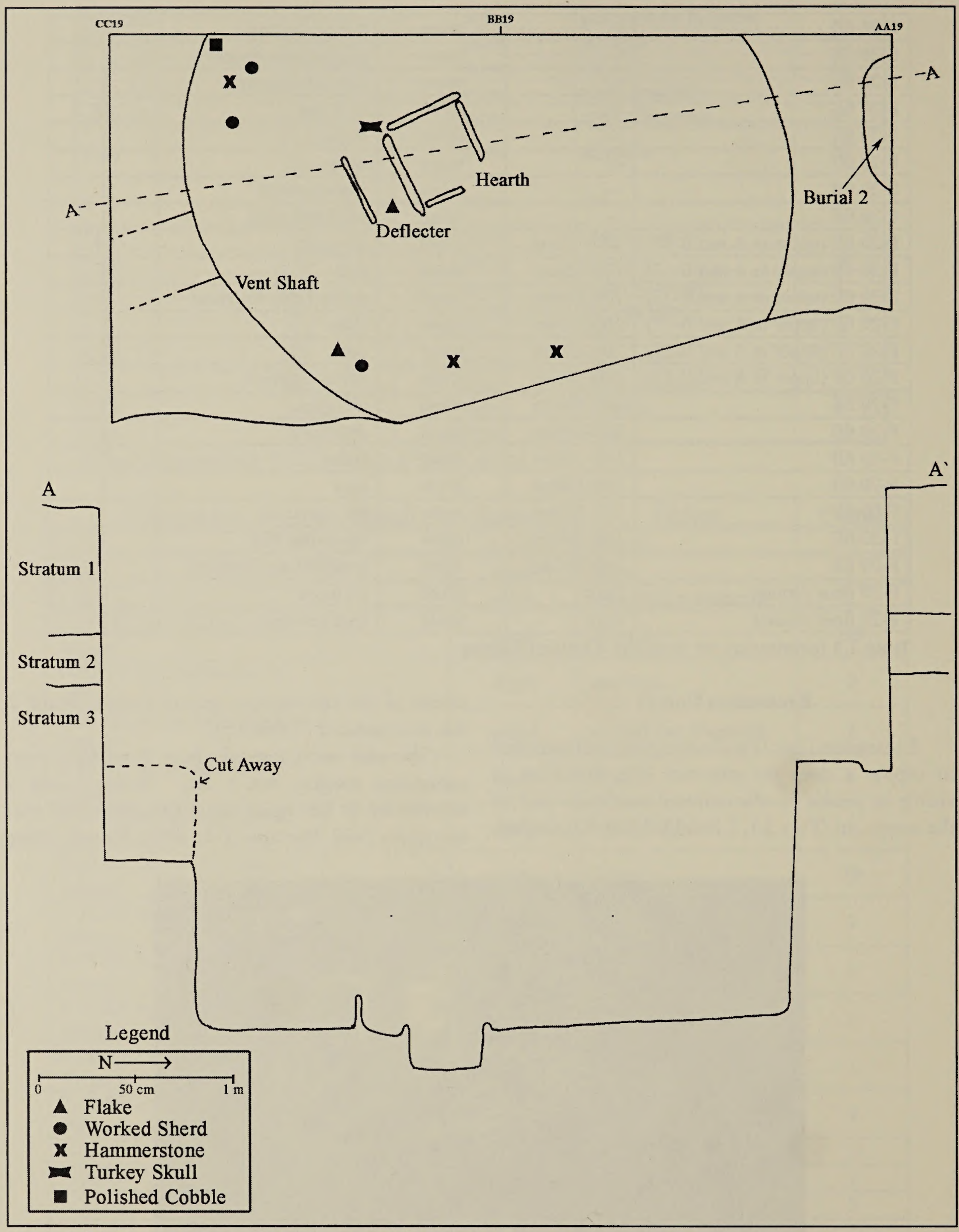


Figure 3.34. Plan and cross-section drawing of Pit Structure 2.

precisely how much of the structure remained in the bank, the excavation unit actually exposed only about two thirds of the pit structure (Fig.3.35). The remaining fill of the structure was used to provide an exceptional profile of the structures fill and overburden (Figs.3.36, 3.37).

Pit Structure 2

Excavation of the feature involved the rapid removal of the Stratum 1 overburden with shovels (Fig. 3.33). This deposit was non-cultural, although a few sherds were encountered on the north end near a pocket of gravel. After Stratum 1 was removed and the Stratum 2 deposit was exposed, vertical control was established and the excavation proceeded by removing the deposit in 20 cm levels. Fill of the deposits was selectively screened.

Some difficultly was encountered in defining Pit Structure 2 in plan on its south side, due to slumping/ erosion of the upper wall. On the north edge, a surface cut into Stratum 3 appears to have formed a high bench about 125 cm above the floor (Figs. 3.34, 3.35). The Burial 2 pit was initially defined on the bench at this level. It was not positively determined whether Burial 2 preceded or postdated the construction of Pit Structure 2, although it seems most likely that the burial occurred after the structure was abandoned.

Fill. The upper 125 cm of fill in the Pit Structure 2 was a midden deposit consisting of lithics, small tools, abundant sherds (some large and probably restorable), scrap bone, and sandstone all in a dark sandy matrix containing small charcoal fragments, lenses of ash, and laminates of clay (Fig. 3.36, 3.37). The deposit included an impressive number of tools and artifactual debris (Table 3.4).

Underlying the upper midden deposit, at a depth of 2 m, the fill was characterized by laminates of orange and yellow sand with large chunks of charcoal and some large rock, suggested episodes of dumping of structural debris along with household trash. A massive red clay deposit on the south side of the structure seems to have been the result of slumping, which as noted, made the bench difficult to define.

Found at the 230-250 cm level was a massive amount of unshaped, partially burnt, irregular rock. The volume of this material amounted to two wheelbarrows full. The burned jacal, charcoal, clay, and sand suggested a post-occupational dumping event; however, it is possible that this material originally formed part of an upper wall that rested on the bench. An impressive number of heavy stone tools were associated with this deposit. They included: hammerstones (7), ground stone (1), a core (1) and a polishing stone (1).

The lower 20 cm of Pit Structure 2 fill consisted of a massive unit of homogeneous, fairly clean, red clay that presumably represents the collapsed roof and upper walls. This level was virtually devoid of artifacts. At this point in the excavation, a thunderstorm flooded the arroyo and saturated the

Figure 3.35. Vertical view of Excavation Unit D, defining Pit Structure 2.

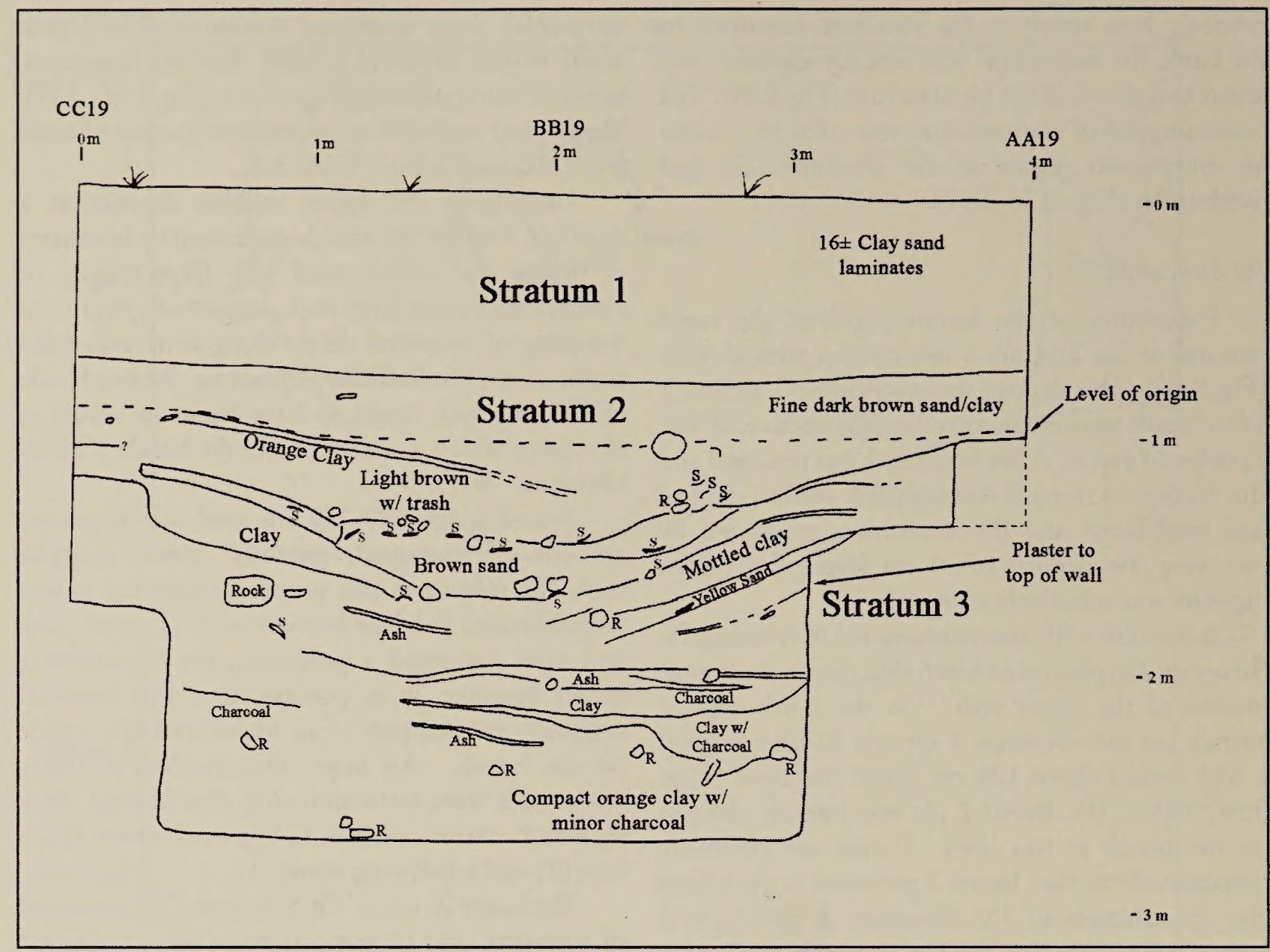


Figure 3.36. Profile of Pit Structure 2 fill exposed in east wall of Excavation Unit D.

deposit. Without the moisture from this flood event, a pick would have been required to remove the clay fill. The final definition of Pit Structure 2, although only a partially excavated remnant, was very similar in size and construction to Pit Structure 1. It also demonstrated a similar post-occupational use as a midden dump (Fig. 3.37).

Walls. The walls rise vertically from a tight radius with the floor. Plaster adhered to the wall surface in a few places. Elsewhere, the walls are simply the exposed surface of the Stratum 3 clay.

Floor. The floor is a smoothed and level clay surface created by simple use and/or polishing of the underlying Stratum 3 clay. The surface was stained with ash in the vicinity of the hearth and elsewhere was covered with a thin use deposit that separated it from the roof clay.

Floor Features. Three related and aligned features occur on the floor of the structure: a vent shaft, a slab-lined hearth, and a slab deflector (Fig. 3.38).

The vent shaft is an unlined tunnel extending south-southeast at floor level. The interior of the feature is nearly circular, 30 cm in diameter, expanding to a rectangle 45 cm wide and 50 cm high at its opening into the room. Fill consisted of sandy clay laminates with 16 small rocks, charcoal fragments, a Dogoszhi-style sherd, one sherd of Tsegi Orange Ware, a corrugated sherd, and three scrap bone fragments.

The hearth was a formal, well-built feature located slightly off-center in an alignment with the vent shaft and the deflector. It was square and constructed of four dressed sandstone slabs measuring 48 cm and 50 cm on a side. A gap occurred on the northeast corner. Overall depth of the feature was 20 cm with the slabs rising vertically 5 to 7 cm above the floor. Fill of the hearth consisted of 15 cm of well-combusted white ash with the remains of a partially burned piece of juniper in the upper portion. Near the bottom, on the south edge, was a pocket of small charcoal fragments.

Figure 3.37. Pit Structure 2, final definition.

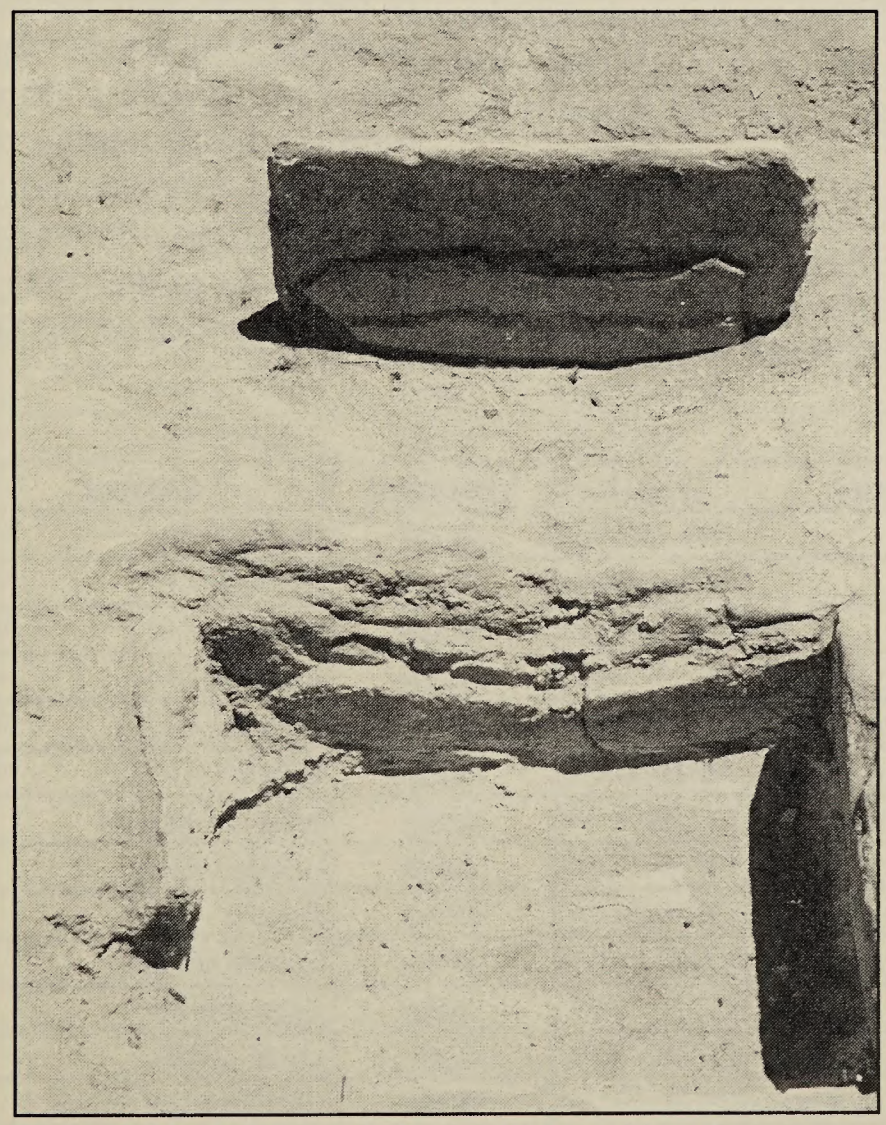


Figure 3.38. Pit Structure 2, detail view of hearth and deflector

The deflector lay directly between the hearth and the vent shaft. It was set firmly into the floor surface 75 cm out from the wall and 20 cm from the hearth. The slab was well shaped and dressed measuring 18 cm high by 36 cm wide. It was 6 cm thick at the base and 2 cm wide at the top. The area around the slab was slightly depressed and filled with ash.

Floor contact artifacts. Artifacts were considered in "floor contact" at 5 cm above the floor and 270 cm below the modern ground surface. A variety of tools, several in actual contact with the floor, were located in an arc around the south side of the hearth. They included: hammerstones (2), scoops made from modified Tsegi Orange Ware sherds (3), a polished cobble (1), several flakes, and the skull of a turkey.

Excavation Unit D, Descriptive Summary

Pit Structure 2 is a fully subterranean earthen pit structure with formal floor features that are, to date, unique north of the Colorado River. This configuration is a marked departure from the benched pit houses of the preceding Early Pueblo II Period (AD 900 – 1050) and the similarities to Kayenta architecture are obvious. Perhaps the most notable Kayenta feature that was absent is the sipapu.

There is no strong evidence that Pit Structure 2 burned but it may have been subject to sudden collapse. Numerous household artifacts on the floor suggest it functioned as a domicile up until the point it was abandoned.

Subsistence data from Pit Structure 2 came from multiple sources. Pollen analysis of a sample taken from the floor yielded a relatively large quantity of maize pollen, species in the parsley/carrot family, and possibly dandelion or chicory. Macrofloral analysis yielded two maize fragments as well as Amaranthus sp. and Poaceae. The skull of a turkey on the floor near the hearth could have been used for ritual, as a food source, or both

A single cotton (*Gossypium*) pollen grain was identified in the floor contact sample that demonstrates that the occupants either had access to, or actually grew, cotton. The number of "spindal whorls" recovered on site may be associated with spinning of cotton fiber.

Two radiocarbon dates were run on carbon samples from Pit Structure 2. Small charcoal fragments from the hearth yielded a calibrated date of AD 780–1035 (Beta-77114). A charcoal sample recovered from floor contact in the structure produced a date of AD 705–1020 (Beta–77111). Given the Late Pueblo II period (AD 1050–1150+) corrugated and red ware sherds on the floor of the structure, both of these dates were too early – apparently a result of dating "old wood." Subsequently, a third date was obtained from a charred corn kernel retrieved from the hearth during the macrobotanical study. This AMS date produced a calibrated date of AD 1165-1260 (Beta–117941). This Pueblo III era date is very close to the AMS date of AD 1205–1280 (Beta- 117940) from Pit Structure 1.

Provenience	Depth	Material	Object	Count
F-11 fill, CC20	100-145cm	sherd	unfired clay	2
F-11 fill, CC20	100-145cm	sherd	all types	39
F-11 fill, CC20	100-145cm	stone	flake	2
F-11 (Feature 2 midden)	CC19	sherd	all types	431
F-11 (Feature 2 midden)	CC19	sherd	ceramic object	1
F-11 (Feature 2 midden)	CC19	stone	biface	1
F-11 (Feature 2 midden)	CC19	stone	biface fragment	3
F-11 (Feature 2 midden)	CC19	stone	utilized flake	4
F-11 (Feature 2 midden)	CC19	stone	flake	88
F-11 (Feature 2 midden)	CC19	stone	cobble scraper	1
F-11 (Feature 2 midden)	CC19	stone	edge grinder	1
F-11 (Feature 2 midden)	CC19	stone	stone object	1
F-11 (Feature 2 midden)	CC19	stone	groundstone object	1
F-11 (Feature 2 midden)	CC19	stone	sandstone object	1

Table 3.4. Pit Structure 2 Artifact Log.

F-11 (Feature 2 midden)	CC19	bone	unmodified	3
F-11 (Feature 2) BB19	110-130cm	sherd	all types	348
F-11 (Feature 2) BB19	110-130cm	sherd	handle	1
F-11 (Feature 2) BB19	110-130cm	sherd	modified-disk fragment	2
F-11 (Feature 2) BB19	110-130cm	sherd	clay coil	2
F-11 (Feature 2) BB19	110-130cm	sherd	clay object	1
F-11 (Feature 2) BB19	110-130cm	stone	biface fragment	1
F-11 (Feature 2) BB19	110-130cm	stone	utilized flake	6
F-11 (Feature 2) BB19	110-130cm	stone	flake	73
F-11 (Feature 2) BB19	110-130cm	stone	cobble scraper	1
F-11 (Feature 2) BB19	110-130cm	stone	core scraper	1
F-11 (Feature 2) BB19	110-130cm	stone	groundstone object	7
F-11 (Feature 2) BB19	110-130cm	stone	modified sandstone	1
F-11 fill, CC19	110-130cm	sherd	all types	124
F-11 fill, CC19	110-130cm	sherd	handle fragment	1
F-11 fill, CC19	110-130cm	stone	flake	7
F-11 fill, CC19	110-130cm	stone	groundstone object	2
F-11 fill in BB19	125-145cm	sherd	all types	19
F-11 fill in BB19	125-145cm	sherd	all types	228
F-11 fill in BB19	125-145cm	sherd	clay coil	1
F-11 fill in BB19	125-145cm	stone	flake	18
F-11 fill in BB19	125-145cm	stone	groundstone disk	1
F-11 fill in BB19	125-145cm	stone	sandstone disk	1
F-11 fill in BB19	125-145cm	stone	groundstone object	3
F-11 fill in CC19	130-145cm	sherd	all types	109
F-11 fill in CC19	130-145cm	stone	flake	3
F-11 fill in CC19	130-145cm	stone	groundstone object	1
F-11 fill in CC19	145-155cm	sherd	all types	278
F-11 fill in CC19	145-155cm	stone	flake	8
F-11 fill in CC19	145-155cm	stone	edge grinder	1
F-11 fill in CC19	145-155cm	stone	groundstone object	1
F-11 fill in CC19	145-155cm	bone	unmodified	1
F-11 fill in BB19	145-155cm	sherd	all types	49
F-11 fill in BB19	145-155cm	stone	flake	1
F-11 fill in BB19	145-155cm	stone	cobble	1
F-11 fill in BB19	145-155cm	sherd	all types	189
F-11 fill in BB19	145-155cm	sherd	handle fragment	1
F-11 fill in BB19	145-155cm	stone	flake	9
F-11 fill in BB19	145-155cm	stone	mano fragment	1
F-11 fill in BB19	145-155cm	stone	groundstone object	2
F-11 fill	155-165cm	sherd	all types	465
F-11 fill	155-165cm	sherd	disk	1
F-11 fill	155-165cm	sherd	modified	1
F-11 fill	155-165cm	stone	biface fragment	1
F-11 fill	155-165cm	stone	flake	28
F-11 fill	155-165cm	stone	sandstone disk	1
F-11 fill	155-165cm	stone	modified sandstone	2
F-11 fill	155-165cm	stone	groundstone object	5
F-11 fill in CC19	155-165cm	sherd	partial reconstructible corrugated vessel	37

Table 3.4 (continued). Pit Structure 2 Artifact Log.

F-11 fill in CC19	155-165cm	sherd	all types	119
F-11 fill in CC19	155-165cm	stone	projectile point	1
F-11 fill in CC19	155-165cm	stone	bifacially modified	1
F-11 fill in CC19	155-165cm	stone	utilized flake	2
F-11 fill in CC19	155-165cm	stone	flake	6
F-11 fill in CC19	155-165cm	stone	stone object	1
F-11 fill in CC19	155-165cm	stone	edge pounder	2
F-11 fill in CC19	155-165cm	stone	groundstone object	4
F-11 fill	165-185cm	sherd	all types	56
F-11 fill	165-185cm	sherd	decorative rimsherd	1
F-11 fill	165-185cm	stone	utilized flake	1
F-11 fill	165-185cm	stone	flake	7
F-11 fill	165-185cm	stone	edge grinder	1
F-11 fill	165-185cm	stone	edge pounder	1
F-11 fill	165-185cm	stone	basalt fragment	1
F-11 fill	165-185cm	stone	sandstone object	2
F-11 fill	165-185cm	sherd	all types	137
F-11 fill	165-185cm	stone	flake	19
F-11 fill	165-185cm	stone	groundstone object	1
F-11 fill	165-185cm	bone	unmodified	3
F-11 fill	185-210cm	sherd	all types	105
F-11 fill	185-210cm	stone	flake	6
F-11 fill	185-210cm	stone	edge pounder	3
F-11 fill	185-210cm	stone	groundstone fragment	3
F-11 fill	185-210cm	sherd	all types	29
F-11 fill	185-210cm	stone	biface fragment	1
F-11 fill	185-210cm	stone	edge pounder	1
F-11 fill	185-210cm	stone	edge grinder	2
F-11 fill	185-210cm	stone	flake	2
F-11 fill	185-210cm	stone	metate fragment	1
F-11 fill	185-210cm	stone	sandstone concretion	1
F-11 fill	185-210cm	sherd	all types	39
F-11 fill	185-210cm	stone	flake	3
F-11 fill	185-210cm	stone	edge grinder	2
F-11 fill	185-210cm	stone	groundstone object	3
F-11 fill	190-210cm	sherd	all types	88
F-11 fill	190-210cm	stone	utilized flake	2
F-11 fill	190-210cm	stone	flake	6
F-11 fill	190-210cm	stone	core scraper	1
F-11 fill	190-210cm	stone	polishing stone	2
F-11 fill	190-210cm	stone	hammerstone	1
F-11 fill	190-210cm	stone	sandstone disk	1
F-11 fill	190-210cm	stone	mano fragment	2
F-11 fill	200cm	sherd	corrugated rims	3
F-11 fill	210-230cm	sherd	all types	99
F-11 fill	210-230cm	stone	utilized flake	2
F-11 fill	210-230cm	stone	flake	3
F-11 fill	210-230cm	stone	edge scraper	2
F-11 fill	210-230cm	stone	cobble scraper	1
F-11 fill	210-230cm	stone	hammerstone	1

Table 3.4 (continued). Pit Structure 2 Artifact Log.

F-11 fill	210-230cm	stone	sandstone disk	1
F-11 fill	210-230cm	stone	groundstone object	2
F-11 fill	210-230cm	sherd	all types	115
F-11 fill	210-230cm	sherd	clay coil	1
F-11 fill	210-230cm	sherd	clay object	2
F-11 fill	210-230cm	stone	utilized flake	2
F-11 fill	210-230cm	stone	flake	5
F-11 fill	210-230cm	stone	core scraper	1
F-11 fill	210-230cm	stone	polishing stone fragment	1
F-11 fill	210-230cm	stone	edge grinder	3
F-11 fill	210-230cm	stone	stone objects	2
F-11 fill	210-230cm	bone	unmodified	1
F-11 fill	230-250cm	sherd	all types	135
F-11 fill	230-250cm	stone	flake	8
F-11 fill	230-250cm	stone	edge grinder	6
F-11 fill	230-250cm	stone	edge pounder	1
F-11 fill	230-250cm	stone	core remnant	1
F-11 fill	230-250cm	stone	polishing stone	1
F-11 fill	230-250cm	stone	mano fragment	1
F-11 fill	230-250cm	stone	groundstone object	2
F-11 fill	230-250cm	stone	groundstone fragment	5
F-11 fill	230-250cm	stone	modified sandstone slab	1
F-11 fill	250-270cm	sherd	several types	10
F-11 fill	250-270cm	stone	projectile point	1
F-11 fill	250-270cm	stone	flake	1
F-11	fill	sherd	all types	44
F-11	fill	stone	flakes	3
F-11 floor contact	floor contact	sherd	greyware	1
F-11 floor contact	floor contact	sherd	modified (scoop)	1
F-11 floor contact	floor contact	stone	flake	3
F-11 floor contact	floor contact	stone	edge pounder	2
F-11 floor contact	floor contact	stone	anvil	1
F-11 floor contact	lower 5cm	sherd	all types	32
F-11 floor contact	lower 5cm	sherd	handle fragment	1
F-11 floor contact	lower 5cm	sherd	modified (scoop)	2
F-11 floor contact	lower 5cm	sherd	unfired clay fragment	3
F-11 floor contact	lower 5cm	stone	flake	8
F-11 floor contact	lower 5cm	stone	core	1
F-11	spoil vicinity	sherd	all types	75
F-11	spoil vicinity	stone	flake	1
F-11	spoil vicinity	stone	pounding stone	2
F-11	spoil vicinity	stone	edge grinder	1
F-11	spoil vicinity	stone	groundstone object	3

Table 3.4 (continued). Pit Structure 2 Artifact Log.

HUMAN SKELETAL REMAINS

by

Heather Hecht, Douglas McFadden, Heidi Roberts, Sali Underwood

Human remains on the Arroyo site consisted of 2 primary interments, a secondary interment, partial remains in the fill of Pit Structures 3 and 4, and numerous isolated bones. Heather Hecht contributed the osteological inventory and their description with the exception of Burial 2. Douglas McFadden described Burial 2 and provided the context descriptions. Heidi Roberts and Sali Underwood described the disarticulated bone.

Burial 1

Context

Burial 1 is a human interment located in the north bank of the arroyo immediately east of Pit Structure 1 (Fig. 3.2). It appears to have originated within Stratum 2. The burial pit is somewhat bell-shaped and was excavated 70 cm into Stratum 3. Fill of the pit consisted of a brown sandy clay with charcoal and a few corrugated sherds. This feature was exposed in profile by the original arroyo cut and was subsequently looted. The entire pit was dug out with a round-nosed shovel. The partial skeletal remains were found in the backdirt on the floor of the arroyo. Apparently, most of a juvenile skeleton was represented. Artifacts found in the looters spoil include a Bull Creek projectile point and portions of a small Shinarump Brown Ware canteen.

Inventory

Cranial: frontal; L & R parietal; L & R temporal; occipital; L & R zygoma; L & R maxilla; mandible. Post cranial: 2 cervical, 6 thoracic, 4 lumbar vertebrae; 1 sacral element; 3 L, 2 R ribs; R clavicle; 1 scapula; R humerus; 1 ulna; 9 metacarpals and manual phalanges; 1 ilium; R femur; 1 fibula.

Description

No measurements were possible as all long bones were incomplete. The only observable dental traits are shoveling and double shoveling of the upper central incisors. Both traits are pronounced in this individual. The estimated age is 3 years +/-1 year, based on dental development (Ubelaker 1978.) This estimate is supported by the vertebral arch fusion pattern: the lumbar and lower thoracic arches are fused while the upper thoracic arches are unfused (McKern and Stewart 1957.)

There is evidence of remodeled (healed) periostitis on the internal surfaces of the parietals. Mild cribra orbitalia is present on the roof of both orbits. Lytic lesions, both remodeled and active, are present in the frontal bone. Growth resumption lines are observable in the cancellous bone of the tibia, indicating growth disturbances. Changes to bone such as these are generally considered to result from hematogenous infection, although periostitis and cribra orbitalia are often associated with iron deficiency anemia, common in remains from the agricultural period of the prehistoric Southwest (Ortner and Putschar 1985.)

Burial 2

Context

Burial 2 is a primary interment of an infant located 30 cm north of Pit Structure 2 in Excavation Unit D. Approximately 50% of the burial pit was exposed on the surface of the Pit Structure 2 bench. The other half remained in the north wall of the excavation unit. Although the level of origin was obscure, it appears to originate in the lower portion of Stratum 2. Several large rocks occurred above the burial. Because the burial pit is located only 30 cm from the edge of the pit structure and it was excavated into the bench, it is likely that it was excavated after Pit Structure 2 was abandoned. If this is the case, the vessels associated with the burial postdate the AD 1165-1260 occupation of Pit Structure 2.

The burial pit is oriented east – west and is 65 cm long. About 50%, or 15 cm, is exposed in plan on the bench surface. Fill of the pit is a brown, ashy, deposit similar to the midden. Three bones were visible in the fill near the east end; the proximal end of a femur (no articular surface), a possible fibula fragment, and a 10 cm-long tibia (without ephiphyses). On the west end the skull was exposed with ribs visible in the central portion of the pit. Orientation of the burial was head to west, on its back, and in a flexed position.

Associated artifacts included a restorable Sosi style black-on-white bowl (FS-145), a St. George

Black-on-gray bowl with a faint checkered design (FS-157) and a corrugated jar fragment (Fig. 6.1; D, H).

Burial 3

Context

Burial 3 consists of the partial remains of a secondary interment located in the fill of Pit Structure 1. The remains were placed in a shallow oval depression, 240 cm below the modern surface, oriented east - west and measuring 65 cm x 45 cm. No burial pit was visible above the grave indicating that the remains may have been placed in the partially filled structure and then covered with midden. Associated with the remains were five ceramic vessels (Fig 6.1: A, G; Fig. 6.2: A, B, C). With the exception of a small Lino Black-on-gray style cup (Fig. 6.2 C), they are all considered typical late Pueblo II.

Several of the larger post cranial bones were not articulated and were apparently placed in the pit along with the articulated cranium and mandible. Smaller vertebrae and ribs had been inserted into the skull, indicating that the individual had decomposed elsewhere. Two possible explanations for this situation were considered. The first explanation hypothesizes that the individual died in an off-site, possibly remote location. The remains were recovered and subsequently buried in Pit Structure 1. The second explanation hypothesized that the individual was accidentally exhumed on site during the course of excavating one of the many pit structures. The partial remains were then collected and reburied. There were no indications of weathering on the bone to support the first scenario of a lost child, although the remains could have been transferred to the Arroyo site for other reasons. Although there is no direct evidence, the latter explanation appears most congruent with other observations made on the site (see Chapter 12).

Inventory

Cranial: frontal; L & R parietal; L & R temporal; body and L & R grater wings of sphenoid; ethmoid; L and R incus; L & R stapes; L & R malleolus; occipital; L zygoma; L & R maxilla; mandible.

Post cranial: 6 cervical, 7 thoracic, 1 lumbar vertebrae; 3 sacral elements; 4 L, 10 R ribs; R clavicle; L & R scapula; R humerous; R ulna; R radius; 1 illium; R femur; 1 tibia: 1 fibula.

Description

The only possible measurement from this individual was the length of the humerus: 102 mm. This is consistent with an age of 18 months (Scheuer et al. 1980). However, the metopic suture is fused, uniting the frontal and supporting an age of over 2 years (Steele and Bramblett 1988). Dental eruption is consistent with an age of 21 months +/- 8 months (Ubelaker 1978). Concensus age for this individual is 21 months +/- 8 months.

Shoveling is distinct on the deciduous upper central incisor, although dental traits are not generally considered significant on deciduous teeth. There are large (1/2 of the lingual surface) pit type and linear enamel hypoplasias on the deciduous upper canines. These result from a period of distress during the development of the tooth. The particular part of the teeth affected in this case is in the process of development around the time of birth. Disturbances affecting the canines are common during this period (Sciulli 1922.)

The interior surface of the occipital bone shows mild but active periostitis, a sign of infection or other stress. No cribra orbitalia is observable in this individual. The cranium has been culturally modified in the asymmetrical lambdoidal pattern (Reed 1949.)

Partial Remains, Pit Structure 3 Fill

Context

These partial remains were found in the upper fill of Pit Structure 3, 15 cm below the surface of the bench and 150 cm below the surface. No artifacts were associated with the remains nor was a burial pit observed. The bones were scattered and there was no indication that they had been articulated. The top of the skull and the orbits were reversed suggesting that they had been placed in the fill. Fill surrounding the remains consisted of structural debris.

Inventory

Cranial: L & R frontal; L & R parietal; L & R temporal ; body and L & R greater wings of sphenoid; ethmoid; vomer; 1 incus ; 1 malleolus; occipital.

Post cranial: 5 cervical, 5 thoracic, 4 lumbar vertebrae; 6 L, 9 R ribs; L clavicle; L scapula; L humerus; L ulna; L radius; 8 metacarpals and manual phalanges.

Description

Measurements are consistent with an age of 9 months (Scheuer et al. 1980.) The two sides of the frontal bone are unfused, consistent with an age under 2 years (Steele and Branblett 1988.) No dental eruption has occurred on the maxilla or mandible. The first eruption usually takes place between 6 and 12 months (Ubelaker 1978.) The age of the individual is therefore estimated at 7.5 months +/- 4 months. No dental traits or pathological conditions were observed.

Partial Remains, Pit Structure 4 Fill

Context

These isolated human remains were found 103 cm below the surface in the midden/structural fill of Pit Structure 4.

Inventory

Post Cranial: 1 metacarpal; R femur.

Description

The femur measures 253 mm in length without any of the epiphyses. This length is consistent with an age of 6 years +/- 0.5 years (Scheuer et al. 1980.) The epiphysis of the metacarpal is also unfused and consistent with this age. No pathological conditions were noted on either bone.

Isolated Human Remains

Isolated human remains mainly consisted of small, generally broken bones scattered throughout the fill of the pit structures. Table 3.5 describes the location, element, and minimum number of individuals represented in each feature or excavation unit.

Provenience	Depth	Recovered	M.N.
Pit Structure 1			
FS-38	180-200 cm	1 Fragment	
FS-74	120-140 cm	3 Fragments, Rib	
FS-83	140-160 cm	Rib	1 infant
FS-94	180-200 cm	2 Fragments	
FS-303	240-260 cm	5 Infant Fragments	
FS-360	30-50 cm above floor	Child Rib	
Pit Structure 3			
FS-148	100-120 cm	Infant, Bone	
FS-330	---	2 Infant Cranial Fragments	1 Infant, 1 Child
FS-324	180-200 cm	2 Fragments	2 Total
FS-152	120-140 cm	Child Fragment	
FS-340	140-160 cm	Vert., Scapulae	
Pit Structure 4			
FS-302	---	Toe	
FS-346	Top of def. at 110 cm+	Cranium Various (8)	2 Infants, 1 Adult
FS-349	---	Infant, Child, Long Bone, Rib	3 Total
FS-175	---	Childs Right Femur	
A17 Grid Unit			
FS-103	60-80 cm	Cranium	
FS-304	60-80 cm	1 Infant Rib	1 Child
FS-318	90-100 cm	Long bone, Various, Infant	
B17 Grid Unit			
FS-303	60-80 cm	Fragment	1 Child, 1 Infant
FS-331	60-80 cm	Fetal	2 Total
CC20 Grid Unit			
FS-332	100-145 cm	1 Long Bone	1 Child, 1 Infant
FS-135	145-155 cm	Various Infant & Child, Child Long Bone	2 Total
A18 Grid Unit			
FS-63	85-105 cm	Adult Left Femur	1 Adult

Table 3.5. Summary of isolated human remains.

				Element							
	FS #	Provenience	Taxon Certainty	Type	Side	Complete	Age	Sex	Proximity	Quantity	Comments
Excavation Unit B	112	PS1 Fill		RIB		M	I		P	2	
	112	PS1 Fill		RIB		M	I		M	3	
	338	E17		RAD	L	M	I		D	1	
	360	PS1 Fill		RIB	L	T	S			1	
Excavation Unit C	65	PS4, CC19		SCA	R	M	A		D	1	
	67	A18		FEM	R	M	A		M	1	
	92	PS4, BB19	CF	FIB		M	A		M	1	
	103	A17		SKU		L	1			1	
	148	PS3 Fill		RIB		M	I		D	1	
	152	PS3 Fill		SKU		L	I			1	
	152	PS3 Fill	CF	TAR		T	S			1	
	302	PS4 Fill		MET		T	S			1	
	303	B17		MAL	R	T	1			1	
	303	B17		SKU		L	I			1	
	303	B17		CER		M	I			1	
	304	A17		RIB		M	I		M	1	
	313	B17		MET		M	S		P	1	
	313	B17	CF	THO		L	1			1	
	318	A17		MET		T	S			1	
	318	A17		CER		M	I			1	
	318	A17		ULN	R	T	I			1	
	330	PS3 Fill		PAR	L	T	I			1	
	330	PS3 Fill		PAR	R	M	I			1	
	331	B17	CF	ULN	R	T	S			1	
	340	PS3 Fill		SCA	R	T	I			1	
	340	PS3 Fill		THO		T				1	
	346	PS4 Fill		RIB	R	L	S		P	1	
	346	PS4 Fill		RIB	L	L	S		P	1	
	346	PS4 Fill		RIB		L	S		M	1	
	346	PS4 Fill		RIB		L	S		D	1	
	346	PS4 Fill		PH1		T	S			1	Hand
	346	PS4 Fill		TAR		M	S			2	
	346	PS4 Fill		SPH		M	I			2	
	346	PS4 Fill		RIB	L	T	I			1	
	346	PS4 Fill		MEC		T	S			1	
	346	PS4 Fill	CF	HUM		M	I		D	1	
	346	PS4 Fill	CF	RAD		M	I			1	
	349	PS4 Fill		RIB	L	T	I			1	
	349	PS4 Fill		FEM	R	T	I			1	
Excavation Unit D	135	CC20		SCA	R	T	I			1	
	135	CC20		SKU		L	1			1	
	135	CC20		RIB	L	M	S		P	1	
	135	CC20		CLA	L	T	A			1	
	332	CC20		ULN	R	T	I			1	

Table 3.6. Element analysis of isolated human remains.

Chapter 4
Internal Site Chronology and Dating

This chapter describes the sequence of building and abandonment events at the Arroyo site by considering instances of superpositioning, remodeling, accretional construction, and evidence for reuse. It will also consider the overall length of occupation based on ceramic styles, the accumulation of midden deposits in the pit structures, and finally, it provides calendar dates using AMS and conventional radiocarbon dating techniques.

From the outset of the excavation, the straight forward stratigraphy and the association of corrugated ceramics, red wares, and white wares with the main occupational horizon exposed in the arroyo cut indicated that the Arroyo site was occupied during the Late Pueblo II period.

Thirteen radiocarbon samples from the puebloan horizon were dated, in four separate submissions, between 1994 and 1998 (Table 4.1, Fig. 4.1). The utility of working with radiocarbon dating over a period of time is that it allows anomalous dates to be considered and features to be subjected to additional dating, ultimately increasing resolution. Also, for the earlier submissions, the C13/C12 ratios were only estimated, while the most recent dates were actually measured, thereby enhancing their accuracy. All radiocarbon age determinations reported in this section have been calibrated and are presented in calendar years at the 2 sigma, i.e. 95% probability, level.

ABSOLUTE DATING METHODS

This discussion will consider certain temporal relationships: 1) between structures and surfaces within the individual excavation units and, 2) between the excavation units themselves. All dated carbon samples were collected from floor contexts or occupation surfaces with the exception of Beta 100262 from Pit Structure 1, which was collected from fill.

Excavation Unit A

Demonstrating the actual association of Storage Room 1 and Residential Room 1 was problematic due to the arroyo cut having physically separated the two features (Fig. 4.2). Small, twig-sized construction materials were collected from both features. The assumption that Storage Room 1 was remodeled and incorporated into Residential Room 1 on the opposite bank was generally supported by overlapping dates during the 12th or even 13th centuries (Table 4.1, Fig. 4.1).

Excavation Unit B

Charcoal from the hearth of Pit Structure 1 was initially dated to A.D. 960-1065, 1075-1155 (Beta - 66334). A subsequent date taken from charcoal on the floor of the structure (Beta-77113) yielded an identical date (Table 4.1, Fig. 4.1). Hearth charcoal is generally considered a poor material to date due to the possibility of its being "old wood." Recent improvements in dealing with the inherent problems of dating maize led to a third round of dating. Using a measured, rather than estimated C13/12 ratio, three corn cobs from the trash fill (between 180–260 cm) of Pit Structure 1 yielded a composite date of

	Lab Number	Prov.	C 13/12 Ratio	C14 Age	2 Sigma Range	Cal. Midpoint	Material
Excavation Unit A	Beta 77110	Residential Rm 1 Floor Contact	-25.0*	950±60	AD 990-1225	AD 1040	Charcoal
	Beta 66335	Residential Rm 1 Floor Contact	-25.0*	860±50	AD 1035-1275	AD 1205	Charcoal
	Beta 77117	Storage Rm 1 Lower Floor Surface	-25.0*	820±60	AD 1045-1105 1115-1290	AD 1235	Charcoal
Excavation Unit B	Beta 77113	PS-1 Floor	-25.0*	1020±50	AD 960-1065 1075-1155	AD 1015	Charcoal
	Beta 66334	PS-1 Hearth	-25.0*	1020±50	AD 960-1065 1075-1155	AD 1015	Charcoal
	Beta 100262	PS-1 Fill	-13.7	870±80	AD 1010-1290	AD 1195	Corn Cob
	Beta 117940	PS-1 Hearth	-10.0	800±30	AD 1205-1280	AD 1250	Corn Kernel
Excavation Unit C	Beta 77115	PS-3 Post	-25.0*	700±50	AD 1250-1395	AD 1290	Wood
	Beta 77116	PS-4 Floor	-25.0*	840±50	AD 1045-1105 1115-1280	AD 1220	Charcoal
	Beta 77112	F40 Surface	-25.0*	760±60	AD 1180-1310 1365-1375	AD 1275	Charcoal
Excavation Unit D	Beta 77111	PS-2 Floor	-25.0*	1150±70	AD 705-1020	AD 890	Charcoal
	Beta 77114	PS-2 Hearth	-25.0*	1110±70	AD 780-1035	AD 970	Charcoal
	Beta 117941	PS-2 Hearth	-9.2	850±30	AD 1165-1260	AD 1215	Corn Kernel

Table 4.1. Radiocarbon Dates from 42Ka3976.

A.D. 1010 – 1290 (Beta-100262). An opportunity to conduct a fourth round of dating provided the ideal circumstances, a charred maize kernel extracted from the hearth by flotation for the macrobotanical analysis. This specimen yielded an accelerated mass spectrometry (AMS) date of A.D. 1205-1280 (Beta-117940).

Excavation Unit C

Excavation Unit C provided the most internally consistent dates of any excavation unit (Table 4.1, Fig. 4.1). Both Pit Structures 3 and 4, as well as the adjoining F40 surface, were dated. A perimeter post fragment from Pit Structure 3 yielded the latest date on site at AD 1250-1395 (Beta-77115). Pit Structure 3 was superpositioned over Pit Structure 4 which was dated slightly earlier at A.D. 1045-1105, 1115-1280 (Beta – 77116). Both structures were cut into the F40 surface which was dated A.D. 1180-1310, 1365-1375 (Beta- 77112).

Excavation Unit D

Pit Structure 2 is roughly contemporaneous with Pit Structure 1. The initial charcoal dates taken from the hearth and floor, like those from Pit Structure 1, are considered too early as a result of sampling "old wood" (Table 4.1, Fig. 4.1). A subsequent AMS date on a maize kernel extracted

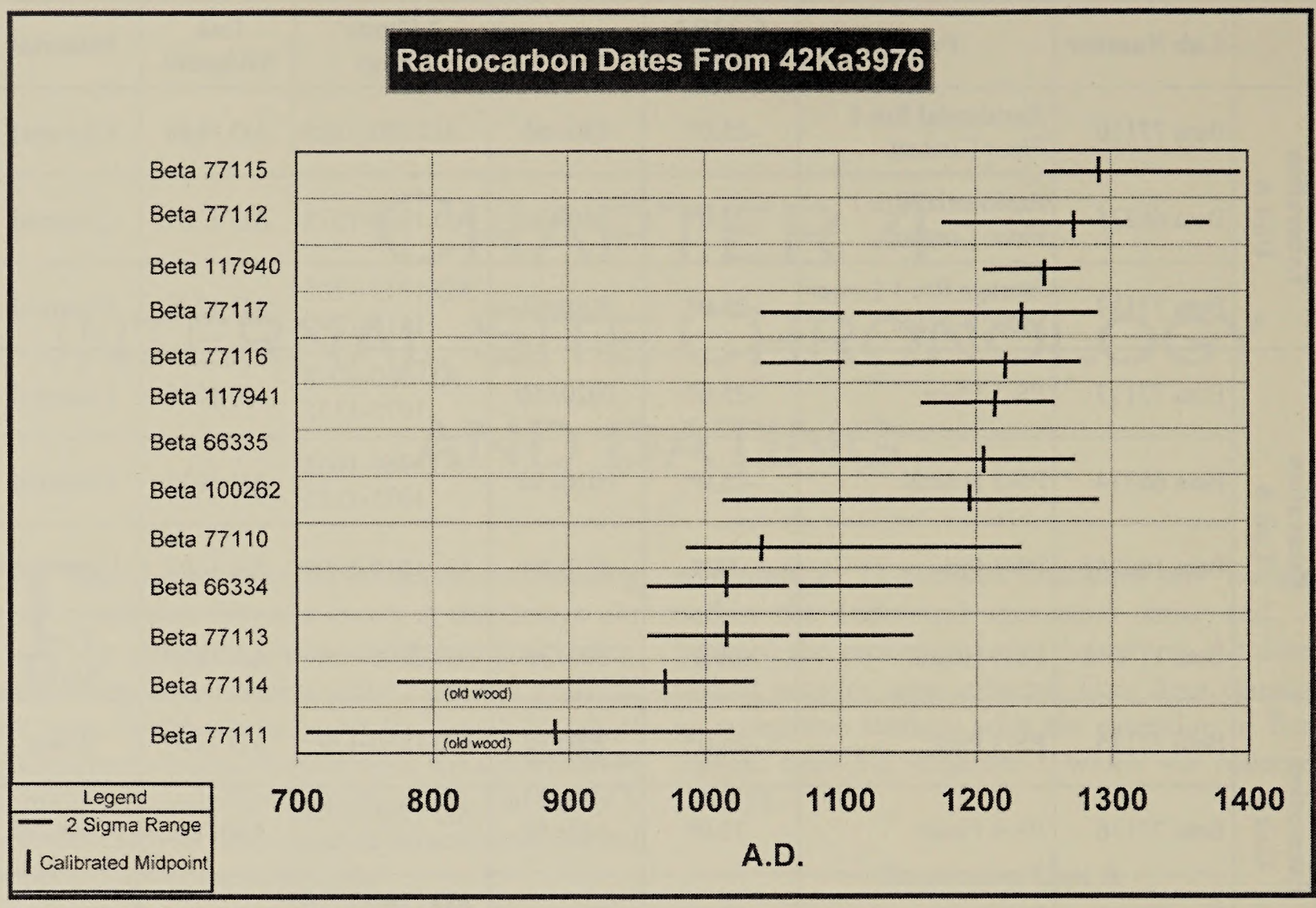


Figure 4.1. Calibrated radiocarbon ranges.

during the macrobotanical analysis yielded a date of A.D. 1165-1260 (Beta 117941) which overlaps with the date for Pit Structure 1.

Several salient points can be made about the suite of radiocarbon dates from the Arroyo site. First, discounting the "old wood" dates, all of the structures were most likely occupied during the late 1100's, with the exception of Pit Structure 3, which appears to have been occupied during the late 13th century. This relatively late occupation is remarkable given that all of the ceramics on site are late Pueblo II styles normally dated A.D.1070-1150. Second, although there are obvious instances of superpositioning, in a statistical sense, the occupation of the structures on site was essentially contemporaneous. The absolute dating methods employed are simply not accurate enough to inform us about the intervals of time that occurred between the occupation of individual structures, nor how long each structure was in use.

RELATIVE DATING METHODS

Based on ceramic cross-dating, the Arroyo site appears to have been occupied solely during late Pueblo II times, or between A.D.1070-1150. Accepting the radiocarbon dates at face value, however, the occupation probably began during Pueblo II and appears to have extended well into Pueblo III times. How long, then, was the puebloan occupation at the Arroyo site? Although roughly contemporary, structures in all 4 excavation units clearly demonstrate superpositioning, remodeling, or some type of reuse (Fig. 4.2). These events suggest a history of episodes of use and abandonment, followed by reoccupation of the site. Aikens (1965) was the first to observe and comment on this phenomena in the Virgin area. At the Bonanza Dune Site, in nearby Johnson Canyon, he encountered a series of superpostioned pithouses that appeared to have been abandoned, stood empty for a period of time (as evidenced by the accumulation of blow sand on the floor), collapsed, and were eventually replaced

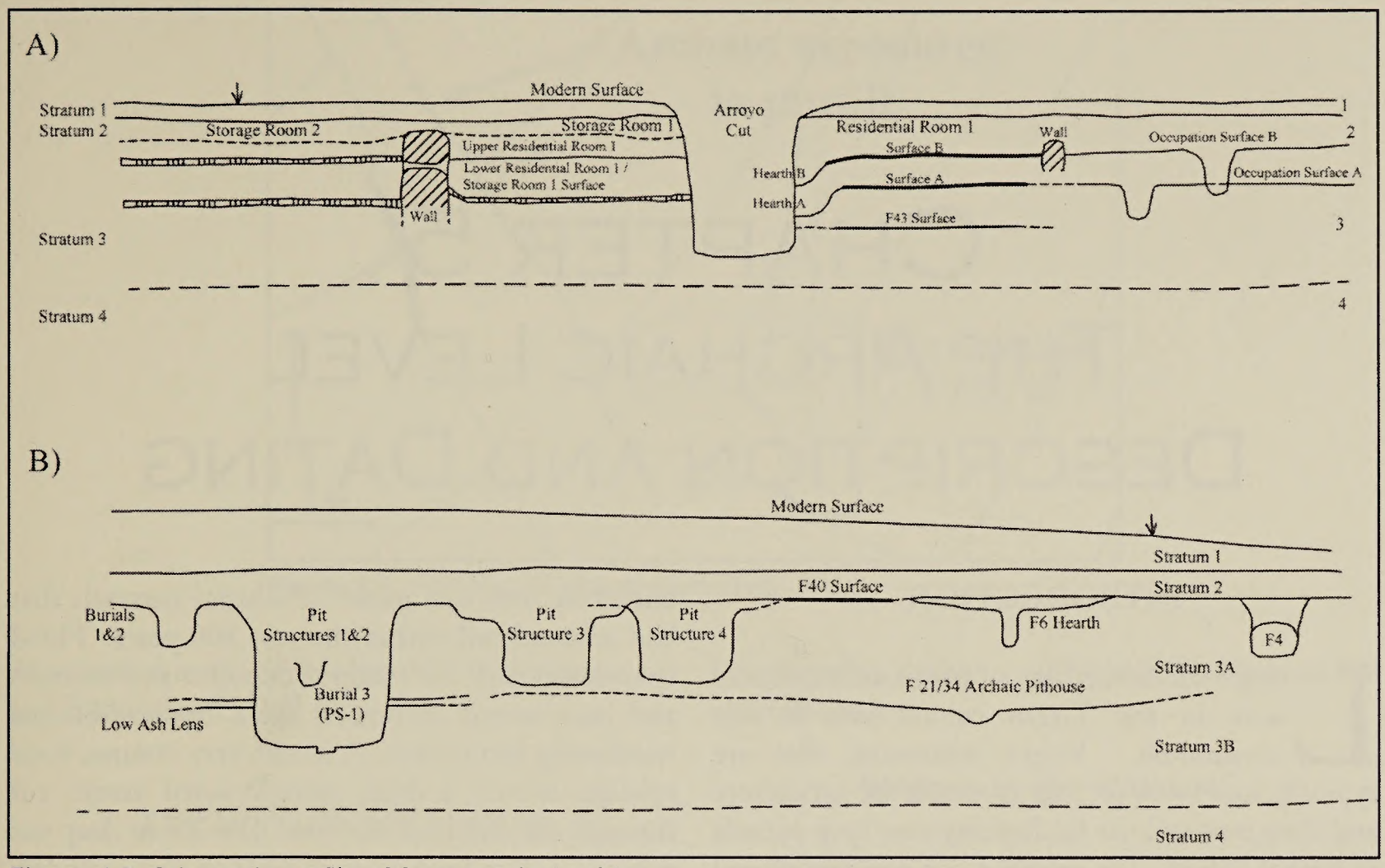


Figure 4.2. Schematic profile of feature relationships.

with new structures built over the earlier ones. Aikens could not determine the length of time that occurred between these construction events.

The best evidence for superpositioning on the Arroyo site occurs in Excavation Unit A where Residential Room 1 displays two hearths, two floors, and an apparent underlying structure represented by Features 43 and 38 (Fig. 3.9). To the south of the room were multiple surfaces that, in some fashion, correspond to Residential Room 1. On the opposite side of the arroyo cut was a roomblock with one partially excavated storage room, Storage Room 2, with two floors and an adjacent storage room remnant, Storage Room 1, that appeared to have been remodeled, and, that was once apparently a part of Residential Room 1 (Fig. 3.4). A superpositioning event also occurred in Excavation Unit C where Pit Structure 3 partially overlies Pit Structure 4. These construction events are likely to have coincided with other activities on site. For example, the razing of Residential Room 1's initial configuration could well have coincided with the fill episode of structural trash in Pit Structure 1, as well as the subsequent construction of a new pithouse. Unfortunately, at present, it is not possible to demonstrate a relationship between these separate events.

The best examples of reuse of a structure for a different function are found with the pit structures themselves. At the Arroyo site, and in the Virgin culture area in general, midden deposits and burials are rarely found in the room block area. Rather, trash deposits and burials are consistently found associated with the scattered pit structures generally located to the southeast. Evidence for the remodeling of pithouses is rare in the Virgin culture area and nonexistent on the Arroyo site. There does, however, appear to have been an expectation that the room block would be remodeled and used again in the future. The pit structures were repositories for impressive accumulations of broken vessels, stone artifacts, bone tools, as well as food scrap, hearth contents, common household trash, and even segments of razed jacal structures. The artifact counts in these structures (Tables 3.1, 3.2, 3.3) are impressive, and alone, suggest that a potentially measurable interval of time occurred as they accumulated. At this point, while the actual intervals of time between building episodes cannot be accurately measured, we can at least infer a process of intermittent occupation at the Arroyo site.

Chapter 5
The Archaic Level Description and Dating

INTRODUCTION

Long-term occupation of puebloan residential sites in the Virgin culture area is not uncommon. Virgin residential sites are typically located in settings favorable for agriculture and their repeated use for farming over long periods of time is logical. The presence of a pre-agricultural Archaic Period horizon deeply buried directly beneath the puebloan level at the Arroyo site can be explained neither in terms of occupational continuity nor a preference for arable soils. We can assume, however, given the substantial nature of the earlier occupation, that its location was selected because it was favorable for a non-agricultural, hunting and gathering, way of life.

Virtually all reported Archaic period sites in the region are located in rock shelters. No open sites with architecture from this period have been reported. The Archaic level description that follows is essentially a test excavation that describes the deposits as understood from exposures in the arroyo bank and Excavation Unit B. A brief discussion of the macrofloral and pollen analyses is followed up with a summary of dated Archaic period sites on the Grand Staircase. Finally, a discussion of the relevance of the Arroyo site deposits and their potential for future investigations within that context is addressed.

SITE DEPOSITIONAL HISTORY

The Anasazi horizon of the Arroyo site was buried by over one meter of alluvial outwash that had accumulated within the past 800 years. Flood episodes sealed the cultural deposits and features and have served to protect them from additional weathering and looters. A recent, very intense, flood episode created a deep, straight-sided arroyo cut through the center of the site. The 2.5 m deep cut exposed a 40 m long Anasazi horizon that included: a masonry room block, two fully subterranean pithouses, two "miniature pit structures," and numerous small features and use surfaces (Fig. 3.1). Excavation units were opened to expose the Anasazi features in plan and they were subsequently investigated.

This chapter describes evidence for a deeper, apparently extensive, Archaic level and an apparent shallow "pithouse" in the stratum that underlies the Anasazi level. The lower stratum is a dense consolidated alluvium that corresponds with a soil unit described by Kulp (1995) as "Pre-Anasazi Alluvium." Kulp places the upper date for the deposition of this unit at 2910 B.P. He goes on to say "While no absolute age data or detailed sedimentology is currently available for these floodplain deposits, it seems likely that they may represent the floodplain environment of the channel system..." (Kulp 1995:21). Excavation undertaken in Unit B indicated that the Pre-Anasazi alluvium lies directly on the Petrified Forest Member of the Chinle Formation.

Because the Anasazi horizon was continuous over the site and only discrete structural features were excavated, areal excavations of the underlying Archaic level was not possible. Thus, investigations

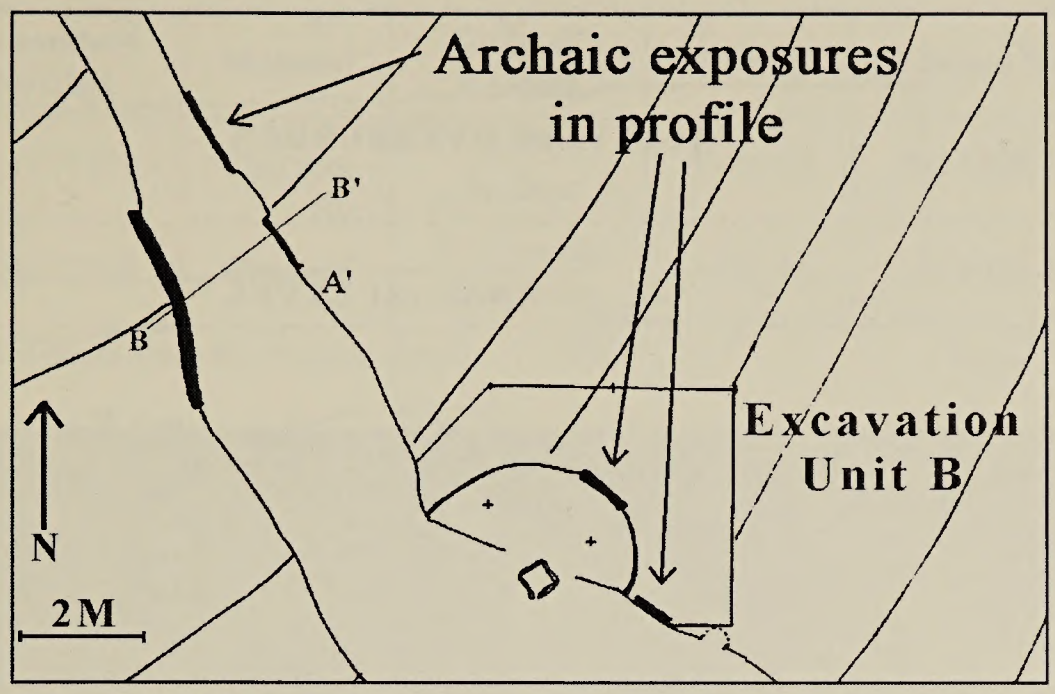


Figure 5.1. Plan map of Archaic exposures.

were limited to the exposed profiles in the arroyo cut and Excavation Unit B (Fig. 5.1)

EXCAVATION METHODS

The initial recording of the Anasazi features at the Arroyo site involved drawing a profile of the east wall of the wash. This continuous vertical face offered excellent control for examining the buried Anasazi features, as well as the deposits above and below them (Fig. 5.2). Numerous sherds and artifacts in the stained sands of the upper level, as well as the features that originated from it, indicated that the horizon was obviously of the Formative period. A distinct lens of charcoal located beneath the Anasazi stratum was noted and drawn. This lens occurred on both the east (F21) and west (F34) sides of the arroyo which, at this point, was about two meters wide (Fig. 5.3). An additional lens of charcoal, at about the same elevation, was noted in the arroyo cut eight meters to the south. While the lens may have been continuous at one time, it appeared to have been truncated by the prehistoric excavation of Pit Structure 1 in Excavation Unit B. Subsequent excavation of the mostly unlined pit structure revealed charcoal in its east wall, offering evidence that, while the lens was not necessarily continuous, a surface occurred at the same elevation in the deposits. In all, exposed profiles of the lower charcoal lenses could be identified over an area measuring 8 x 2 meters (Fig. 5.2). No soil horizon or occupation surface could be identified beyond the charcoal lenses.

Evidence for the "Pithouse"

The excavation of the F34 surface was limited to a 10 cm deep by 20 cm high cut above a distinct soil contact formed by a lens of charcoal-impregnated clay resting on the pre-Anasazi alluvium (Fig. 5.4). The only artifact in the feature was a portable slab milling stone that lay directly on the surface near the south end of this 1.5 m long excavation unit (Fig. 5.5). No occupation surface or level of origin for the F34 surface was discernable in the profile. A composite sample of small charcoal fragments was collected from the lens for radiocarbon dating, a bulk macrofossil sample was obtained, and a pollen sample was taken from beneath the milling slab.

Feature 21, exposed in the opposite bank, was a dish-shaped soil contact nearly four meters long, originating 60 cm below the Anasazi stratum and nearly two meters below the modern surface (Fig. 5.2). Fill above the contact with the pre-Anasazi alluvium was a charcoal/ash and ash impregnated sandy clay similar to that of F34. In the center of the feature was a basin-shaped depression 85 cm in diameter and 30 cm deep. Pollen samples were collected from the surface in the depression and from the alluvium both above and below the feature. A bulk macrofossil sample was collected from the depression.

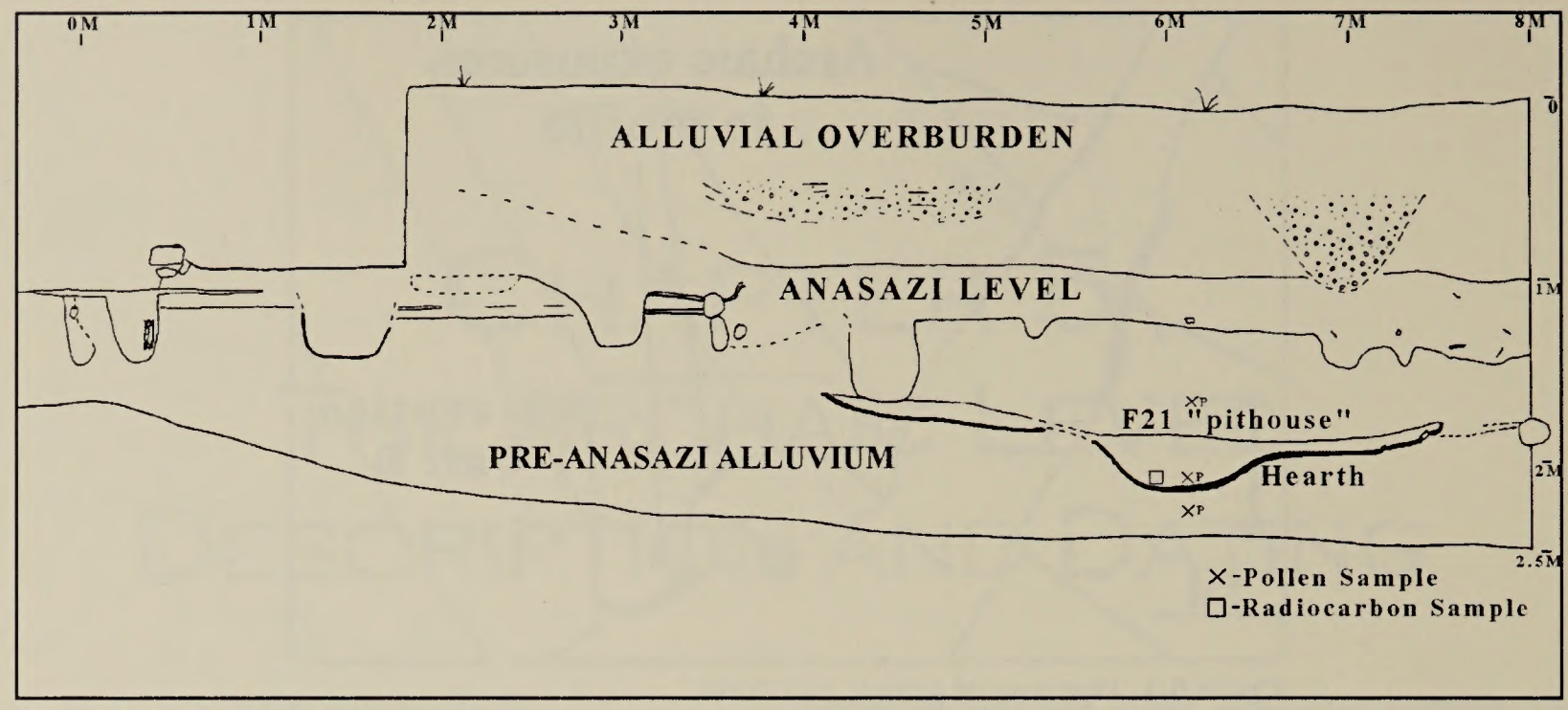


Figure 5.2. Profile A-A`.

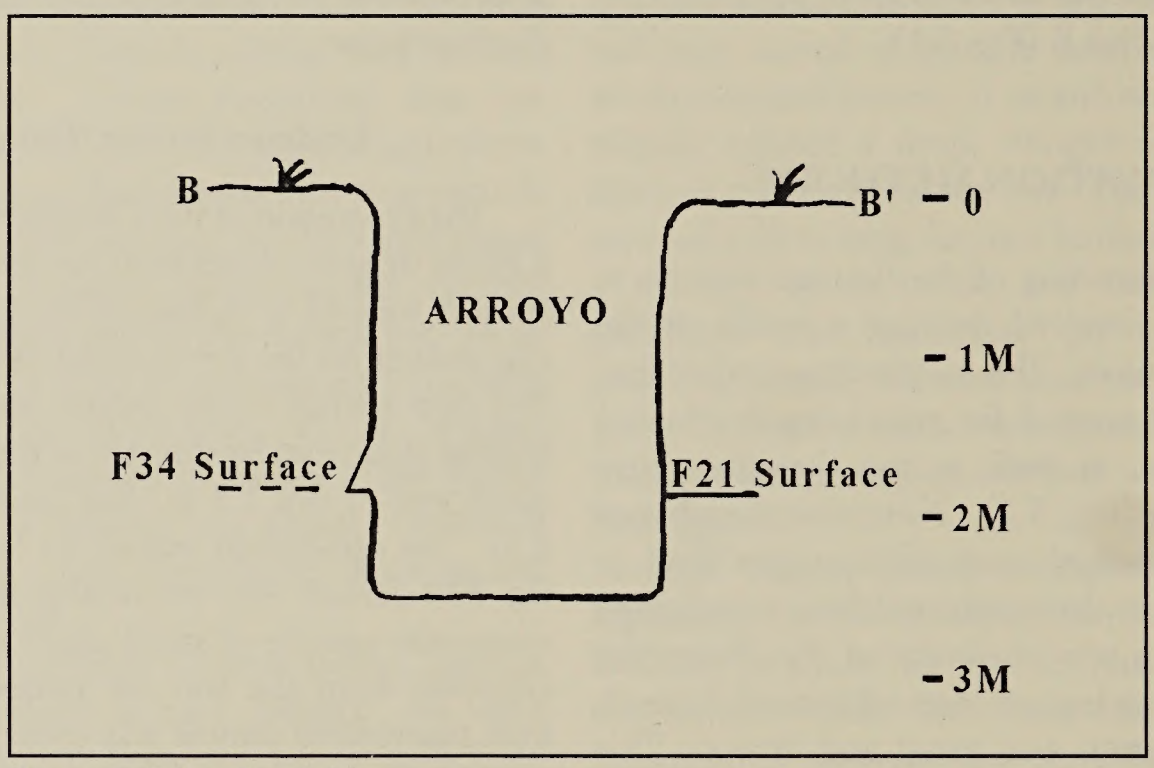


Figure 5.3. Section B-B`

Radiocarbon dates from composite samples of small charcoal indicate that Features 21 and 34 are roughly contemporaneous occupation surfaces (Table 5.1). Additional traits held in common that suggest they belong to the same feature include: their origination at the same elevation in the pre-Anasazi alluvium (Fig. 5.3), the similarity of the F21 and F34 occupation surfaces, and the nearly identical fill above them. Evidence that suggests this common feature is a pithouse includes: the basin-shaped depression which interprets well as a hearth, and a single fragment of burned clay daub that suggests a lightly constructed superstructure of brush and clay.

POLLEN AND MACROFLORAL ANALYSIS

Macrofloral Analysis

Martin (1995) analyzed the remains of carbonized plant materials from the fill of both F21 and F34. A volume of 4.5 liters from the fill of F34 yielded a single Helianthus sp. seed. A volume of 6.9 liters of fill from F34 (which included the "hearth") yielded a total count of 30 charred seeds, including: unidentifiable (13), Cheno-Ams (10), Chenopodium sp. (6), and Asteraceae (1). Also noted in each feature was a small quantity of *Pinus*

Site #	Laboratory Number	Material	Context/ Control	BP age	2 Sigma Range	Cal. Curve
42Ka3976	Beta 77109	Charcoal	F34 West Surface	3370±80	BC 1880-1450	BC 1660
42Ka3976	Beta 77118	Charcoal	F21 Hearth, East Side	3420±90	BC 1935-1505	BC 1705

Table 5.1. Radiocarbon dates from the Archaic level.

Figure 5.4. Collecting charcoal from F34, note milling slab on south end.

sp. bark and needles. No local comparative data exist to assess the significance of these counts. It is noted, however, that these taxa continue to be used during the succeeding Formative period (Martin 1996b, 1997).

Pollen Analysis

Cummings (1995) analyzed pollen from four locations associated with the Archaic level. Pollen samples were collected from beneath the milling slab on the F34 surface, from the "hearth" depression surface in F21, and from sterile contexts both above and below F21 in the pre-Anasazi alluvium (Fig. 5.2).

The pollen samples collected and examined from the Archaic level exhibited a pollen record different from all of the Anasazi samples. The "pithouse" samples were dominated by *Artemisia* pollen; *Pinus* and *Juniperus* pollen counts were generally smaller than those noted in the Anasazi samples. Other species present included Asteraceae, Cheno-ams, *Sarcobatus*, *Ephedra*, and Poaceae. Small quantities of hollow starch granules, and starch granules with hila that are typical of grass seeds, were also recovered. The pollen record from the sample taken beneath the milling slab suggested that sagebrush seeds, Cheno-am seeds, grass seeds and a member of the Solanaceae (potato/tomato) family may have been processed using the milling stone (Cummings 1995).

DATING AND CHRONOLOGY

The two radiocarbon dates from F21 and F34 (Table 5.1) average 1683 B.C (calibrated). This places the pithouse within the Late Archaic Period, 3300-1500 B.C. (Tipps 1995). A key diagnostic of the Late Archaic Period is the Gypsum dart point. Dates for Gypsum projectile points are generally cited as 2500 B.C. to A.D. 500 (Holmer 1986). Based on a reanalysis of dated points from Sudden Shelter, Tipps (1995:52) cites their range as between 3500 and 1500-1000 B.C. for the northern Colorado

Figure 5.5. Milling Slab from F34 Surface (49 cm x 32 cm x 3.5 cm).

plateau. On the Grand Staircase section of the southern Colorado Plateau, Gypsum points seem to have persisted into the Formative period. Eccles and Walling-Frank (1998) describe Gypsum points from securely dated Basketmaker II (circa A.D. 200) contexts at the Reservoir Site on the Utah - Arizona border at Colorado City (Nielson et al. 1996).

Although no projectile points were found in the Archaic level of the Arroyo site, Gypsum points are relatively common on the Grand Staircase (Keller 1987), Kaiparowits Plateau (Geib et al. 2000) and Arizona Strip (Fairley 1989). Keller's (1987) inventory on the Skutumpah Terrace, located about 20 kilometers northwest of the Arroyo site, recorded 10 Late Archaic sites and a total of 34 Gypsum points. A collection of Gypsum points, reported to have been found on the terrace between the Skutumpah and the Arroyo site, are made of Petrified Forest Member chert. The source of this distinctive agatized wood is the Chinle Formation, which is exposed at the base of the Vermilion Cliffs.

In addition to diagnostic projectile points, the Barrier Canyon rock art style, dated between 2,000 B.C. and A.D. 300 in the Canyonlands region (Tipps 1995:168), occurs locally on the Grand Staircase (Judd 1926:122) and supports the impression of a widespread Late Archaic occupation on the southern Colorado Plateau. To date, however, recorded Late Archaic site types on the Grand Staircase are restricted to lithic scatters (Brown 1982), lithic and groundstone scatters (Keller 1987), and rockshelters (Janetski and Wilde 1989). Few open camps and no residential structures have been attributed to the Late Archaic period on the southern Colorado Plateau.

DISCUSSION

In the absence of agriculture, Archaic subsistence practices could have relied on locally available native species. Native floral resources, including Chenoams (goosefoot family and pigweed) and various seed-producing grasses, were available on the valley floor; the modern Paunsaugunt mule deer herd migrates down Kitchen Corral Wash from the high plateaus to their winter range - and probably did so in the past; open range occurs adjacent to the site that was suitable for pronghorn; and sheep habitat occurs in the rugged cliffs above the site. Taking into account resources such as pinyon (*Pinus edulis*) and other upland species available from the surrounding slopes, the Arroyo site could have provided Archaic inhabitants a relatively sedentary base for year-round foraging, or a temporary camp used to exploit seasonally available resources.

Although only tentative conclusions can be drawn from the limited investigations of the Archaic level at the Arroyo site, the data presented here can serve to help formulate a model of settlement and subsistence for the Late Archaic on the Grand Staircase section of the Colorado Plateau. If, in fact, the preferred

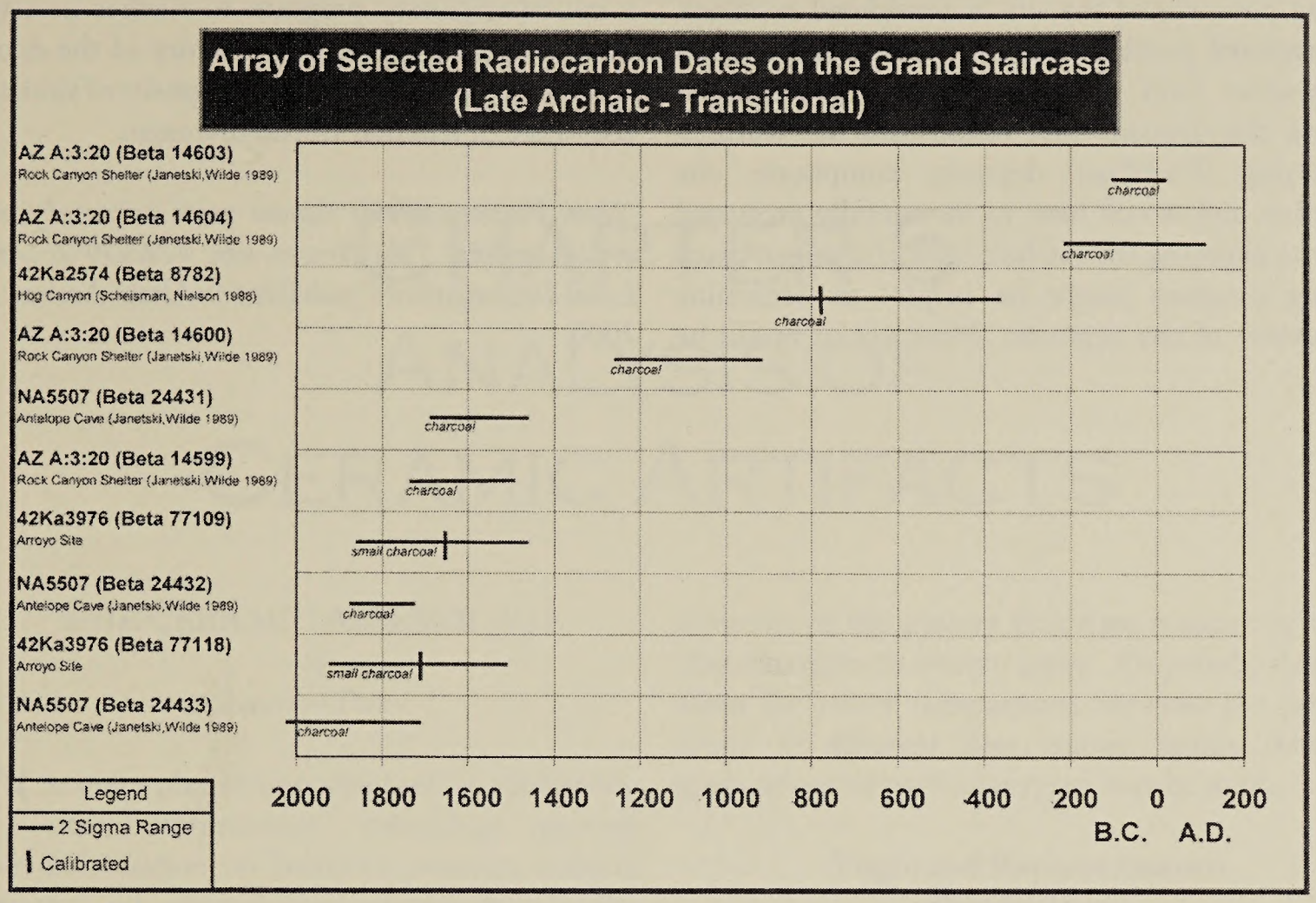


Figure 5.6.

location for semi-permanent Late Archaic camps was in alluviated bottom lands, such sites are likely to be under-represented by inventories that rely exclusively on surface inspection. Ultimately, their identification may require geomorphological studies of sediments and buried soil horizons exposed in wash profiles of the numerous alluvial- filled valleys on the Grand Staircase.

The identification of an in situ Late Archaic population on the Grand Staircase has important implications for understanding the origins of Virgin Anasazi agriculture. Was the local adoption of agriculture a process of diffusion to existing bands of hunter-gatherers, or was the spread of maize the result of a migration of agriculturalists from the south (Berry and Berry 1986)?

In support of the migration hypothesis, Geib and Davidson point out that there appears to be an occupational hiatus in the deposits of rockshelters in the Four Corners area, roughly 3,500 to 2,500 years ago - just prior to the advent of Basket Maker II culture (Geib and Davidson 1994:201). On the Grand Staircase, the continuity of occupation is unclear as only a few sites have been dated to the period immediately preceding the relatively well-known Basketmaker II era (Fig. 5.6). The handful that have been reported only hint at the presence of a population large enough to adopt the Formative lifeway. Further, all of the available dates are the result of limited excavations that lack the context to flesh in details of local settlement pattern and adaptive strategy.

Nevertheless, the diffusion of agriculture to an existing population on the Grand Staircase remains a viable hypothesis. Both the wide distribution of Late Archaic rock art styles, and particularly the temporal continuity of Gypsum projectile points, suggest that there was no occupational hiatus on the Grand Staircase immediately prior to the introduction of agriculture. If an in situ population of Archaic foragers is eventually described, local adaptation - rather than population migration, may best account for the distinctiveness of the emerging Virgin Basket Maker II culture.

Future Investigations

Preservation of pollen and macrofloral remains in the Archaic level deposits of the Arroyo site is good. Given the amount of organic material present

dating potential of the site is considered excellent. The exposed profiles in the arroyo bank and within Excavation Unit B could easily be opened to expose the deposits and encompass the features. Overlying Puebloan deposits complicate the situation and would have to be carefully excavated prior to exposing the Archaic level. An auger-based testing program might be helpful to determine the extent of the deposits. Most useful would be a multidisciplinary program to further investigate the nature and depositional history of the deposits and the potential to recognize deposits of similar age elsewhere in Kitchen Corral drainage.

**Note: Portions of this chapter were extracted from an article entitled "The Arroyo site, 42Ka3976: Archaic Level Investigations" published in* Utah Archaeology 2000.

Chapter 6
Analysis of Ceramic Artifacts

THE CERAMIC ASSEMBLAGE

by
Laureen Perry

Ceramics play an important role in prehistoric site interpretation providing general information on behavior patterns, cultural affiliations and chronological placement. In the Anasazi regions of the Southwest, typologies have been developed over years of study beginning primarily with the works of Harold S. Colton. Colton's typologies are still basically used with some modifications to identify pottery found in the Virgin and Kayenta Anasazi regions. 42Ka3976 is located in an area that could be considered the far eastern edge of Virgin Anasazi territory or the western edge of Kayenta Anasazi territory. The analysis of the pottery from this site has important implications in understanding the people who lived here.

Prehistoric pottery was made using clay and either natural non-plastic inclusions or added temper. These are the primary materials examined for comparisons during analysis. Anasazi pottery is defined as being made using a coil-and-scrape method so pottery displaying a different construction method would be considered to be non-Anasazi. The surface treatments, including surface finishing and painted designs, are also used as indicators for identification and chronological purposes. Vessel form provides information on site usage. Although pottery types for this and surrounding areas have been defined, inconsistencies exist in the applications of those types. In this analysis, the focus will be on characterizing the material composition and design elements of the pottery first then comparing those characteristics to known types. Hopefully, this will allow for better comparisons between the pottery found at different sites where slightly different applications of particular types may be used.

Virgin and Kayenta Anasazi Pottery Types

42Ka3976 lies near what is considered to be "boundaries" for the Virgin and Kayenta Anasazi regions. The pottery from this site would therefore be expected to be either Virgin Anasazi, Kayenta Anasazi or a combination of both. There is also the possibility that it fits in none of these groups. Colton and Hargrave (1937) separated pottery from the Arizona Strip into wares, series and types based on construction methods, composition, and surface treatments. These descriptions include a time frame and range of occurrence. Over the years since then, researchers have modified these types still basically following Colton and Hargrave's typology. Both the Virgin and Kayenta Anasazi areas have defined pottery types used primarily to aid in identification of cultural affiliation, time periods, and behavioral patterns at archaeological sites. An understanding of the previously described types helps to develop an analytical strategy for pottery found at a site.

The most commonly found kinds of pottery are the utility wares or those without painted designs or special clays. The gray wares in the Anasazi region include both undecorated plain and corrugated pottery. Colton and Hargrave placed this pottery for both the Virgin and Kayenta Anasazi areas

into a general category called Tusayan Gray Ware (1937:190-191). The basic description includes construction by coiling and primarily gray in color with "abundant quartz sand" temper. The range of Tusayan Gray Ware covers a large area from southern Nevada across the Arizona/Utah border into southwestern Colorado and northwestern New Mexico with some types more localized. These early descriptions and ranges can still be applied overall to this pottery with some variation between localized areas and time periods. Wider ranges in the descriptions of these gray wares seem to be acceptable as more variations in coloring and temper composition are found. When plain pottery can be narrowed down to a more localized source of production based on its composition, researchers are then able to trace the movement of that pottery from its area of production. The unique olivine temper in Moapa Gray Ware has allowed its source of manufacture to be narrowed down to the Toroweap area north of the Grand Canyon (Lyneis 1992:71). This pottery has been found in varying amounts throughout the Virgin Anasazi region (Lyneis 1995:230).

Another plain kind of pottery of major concern in this area around 42Ka3976 is the Shinarump type which is poorly defined but seems to be most abundant here. Colton described Shinarump Brown based on pottery described by Spencer as having "dark gray, often tan or light reddish brown surfaces" and "abundant opaque angular fragments" as temper (1952:57). Lyneis, recently researching the "Shinarump problem," states that in the Virgin region this type came to be used for pottery with darker colored clay than North Creek Gray, especially in the eastern portion (1998:2). Shinarump has been used like a catchall for undecorated darker, sometimes vitrified, pottery with an apparent lack of a common definition between researchers. Lyneis compared a sample of Shinarump pottery from across the Virgin Anasazi region using petrographic analysis of thin-sections. The characteristic that seems to distinguish Shinarump Plain is its clay with a higher iron content that results in darker fired colorings (Lyneis 1998:21). The colors range from gray to dark gray and from light red to red with vitrification frequent. Lyneis points out that the temper is variable being principally from quartz sands with other materials present which makes the source of the temper difficult to determine (1998:21). The temper found in the Shinarump sample can also be found in North Creek Gray pottery but the coloring of the clay is the distinguishing factor. Using clay color to separate this prehistoric pottery has problems of its own due to the uncontrolled firing conditions during manufacture that produce variable clay colorings even within individual pots. The pottery from 42Ka3976 has the potential to examine this problem at one site, especially since this is near the probable Shinarump production locale (see the discussion in Lyneis 1998).

Painted pottery from the Kayenta/Virgin Anasazi regions provides more information on chronology and trade than plain pottery. Colton and Hargrave (1937) described painted pottery from the Kayenta Anasazi region defining design styles used for the different types made in different time periods. These design styles have been used with the type names (i.e. Black Mesa design style has pendant dots) to describe and identify painted pottery from both the Kayenta and Virgin Anasazi regions. Researchers have begun to notice some differences between Kayenta and Virgin designs (Allison 1998:9-8, 9-9; Walling et al. 1986:354). In 1986, Richard Thompson developed a chart comparing Tusayan Series (from the Kayenta region), and Virgin Series and Moapa Series (both from the Virgin region) time spans for selected pottery types including painted pottery (Walling et al. 1986:355). He proposed separate Virgin Series type names for pottery made in the Virgin area filling in names for types not named by Colton (Walling et al. 1986:352). The design styles used still basically follow Colton and Hargraves' definitions. The separate Virgin Series names allow for identification of Virgin Anasazi made pottery as opposed to Kayenta Anasazi made pottery. Not all researchers have adopted these names and dates but this serves as a reminder that Kayenta definitions and dates do not necessarily correspond to Virgin Anasazi pottery. More research being done in the Virgin Anasazi region will help to better define and date the pottery of this region itself.

Design styles are most readily observed on whole vessels where the patterning and relationships of painted elements can be seen. Although some reconstructable vessels were found at 42Ka3976, the majority of the pottery found is in the form of sherds. The amount of a painted design present

depends mainly on the size of the sherd. Allison (1998) used three basic characteristics of Anasazi design elements in his analysis of a Virgin Anasazi site. These characteristics include whether lines are wide (at least 5mm) or narrow (mostly 3-4mm); the presence or absence of solid elements; and the presence or absence and nature of embellishments to the elements (Allison 1998:9-10). Combinations of these characteristics were then used to define types by design style when possible. This system seems to work pretty well for Anasazi pottery since these are the main traits, along with the relationships between the elements, used in design style determinations. This also allows for a characterization of portions of elements present on sherds. These characterizations may then help determine how these painted sherds compare to those sherds with determinable design styles. Descriptions of painted elements found at sites can be compared using these characteristics since illustrations of all painted sherds found at a site are rarely published.

Red wares in the Virgin/Kayenta Anasazi regions are found in smaller amounts with their dates of usage and locations of production more narrowed down than with plain and painted pottery. San Juan Red Ware tempered with crushed andesite is from southwestern Colorado or southeastern Utah dating from AD700-1040 (Christenson 1994:305). Tsegi Orange Ware from the Kayenta area in northeastern Arizona dates later, AD1040-1240 (Christenson 1994:305). A sand-tempered red ware has more recently been described as different than these types and possibly related to Shinarump types (Thompson in Walling et al. 1986:361-65; Lyneis 1998:22-24). This pottery may have been placed in Middleton Red by some researchers although it does not quite fit that definition. Geib reports seeing sherd tempered red ware from the Glen Canyon/Paria Plateau/Kanab Plateau region in which the temper is different from the sherd temper found in Tsegi Orange (pc with M. Lyneis 1998). These red ware pottery types are in the process of being defined and dating has yet to come. The red wares from 42Ka3976 may help this endeavor.

Procedure

A sample of 13,769 potsherds was collected during excavations at 42Ka3976. The focus of analysis on these sherds was to characterize them and attempt to determine if they fall within definitions currently used for typing pottery. Analysis emphasized characteristics generally used to define pottery types of the Southwest including inspection of construction methods, surface treatments, painted design styles, temper compositions, and clay characteristics. Vessel forms (bowls and jars only) were also determined for sherds with reconstructed vessels analyzed separately. Distribution of the pottery was also of importance because of the depth at the site and some contact with features (floors, benches, etc.).

Due to the large number of potsherds, a sampling strategy was designed to focus on the most diagnostic sherds with a representative sample of the other sherds (Table 6.1). Each bag of pottery was first sorted and counted as red ware, painted, plain and corrugated sherds. Rim and body sherds of plain and corrugated pottery were also counted. These counts were recorded for each Field Specimen Number and Bag Number to be used as feature and level summaries, then the sample to be analyzed was selected. All red wares and painted potsherds were examined. All of the sherds in bags with fewer than 50 sherds or collected from floor, bench, and other feature contacts were analyzed. In lots containing 50 or more sherds, 40% of the plain and corrugated sherds were analyzed with all of the red ware and painted sherds from those bags. Whole and reconstructed vessels from Pit Structure 4 were examined after the sherd analysis.

A series of categories for the characteristics under examination were developed. Vessel form was recorded as either a bowl or a jar (or indeterminate) without further divisions. The part of the vessel was recorded as either a body sherd, rim sherd, or a worked sherd. Rim sherds were further divided by rim eversion as none, slight, more, strong and inverted (following Colton's Lip Direction Chart 1952:14). The surface treatment found on each sherd was recorded as plain, corrugated, painted, fugitive red wash, and slipped with combinations of these as needed. Temper categories were developed based on the predominant composition noting other key components as well. Clay coloring was noted as red for red wares then in shades of light, medium or dark surfaces and cores. An informal pre-test was performed to develop temper and clay categories.

42Ka3976-Sherd Total and Analyzed Counts				
Surface Treatment	**Total Counts**	**Percentage of Total**	**Total Analyzed**	**Percentage Analyzed**
Redware	527	3.8%	527	100%
Painted	1883	13.7%	1883	100%
Plain	1631	11.8%	782	48.0%
Corrugated	9720	70.6%	4507	46.4%
Indeterminate	13	0.1%	0	0.0%
Total	13774	100.0%	7699	55.9%

Table 6.1. Total sherd counts and total sherds analyzed for 42Ka3976.

All selected sherds were then examined for the same characteristics with design elements and styles added to painted sherds. Colton and Hargraves' Kayenta design styles (1937:205-226) were used whenever enough of a design was present with elements described based on Allison's work (1998) for other sherds.

A pretest was performed on a couple of hundred sherds from four different bags of pottery to test the application of categories and to develop codes within them. Initially, the clay was grouped by coloring, such as, gray, gray-brown, red, etc. Separating different clay colorings proved to be most difficult in the plain and corrugated pottery. The problem with multiple colors and shades in individual sherds made this coding too complex. A sample of sherds with different clay colorings and textures were re-fired to check for patterning in clay characteristics. No distinct patterns were found. For the overall analysis, the clay was separated into dark, medium and light with special notations for outstanding characteristics, such as, a finer texture or very white coloring.

Black-on-gray/white, plain and corrugated pottery was analyzed bag by bag. The red wares were pulled out to be analyzed all together for better comparisons of their characteristics as a group. After the pottery was analyzed as proposed, the data was entered into a Panorama II database. This data was compiled and put into tabular forms for presentation. Assigning a type was to be done after grouping them by characteristics and determining if they "fit" into described types. A site chronology was then developed using the pottery findings.

Re-Fired Sherd Sample

Forty-one sherds with a variety of different colorings and surface treatments were chosen to be re-fired under standardizing conditions (fired to 900-degrees Celsius). This sample included corrugated and plain sherds along with red ware and black-on-gray/white sherds. The sample was selected from the varieties of clay colorings observed in the pre-test. The primary interest was in the differences that might occur between the dark sherds that could be Shinarump Gray Ware and the lighter sherds that could be Tusayan Gray Ware. The painted sherds included sherds with both Tusayan White Ware and Shinarump White Ware characteristics along with a couple of red ware sherds and one possible polychrome sherd. The results are shown in Table 6.2 grouped by the re-fired core Munsell Color Chart readings. Exterior and interior surface colors are also recorded. The slip colors of painted sherds were recorded, too.

The darkest sherds before re-firing that best fit the Shinarump description as dark clay, fired to similar color groupings. The change in coloring after re-firing for these sherds was very little suggesting that the original firing temperature may have been close to 900-degrees Celsius. This could also be due to the effects of high iron content in the clay reducing the temperature of vitrification (Lyneis 1998:12). These sherds also all have temper containing white-coated quartz. Another group with common re-firing results includes one light gray sherd and two black-on-white sherds with almost white clay. These three sherds are the only ones that re-fired to pink/white

RF#	3753	VF	ST	T	ORIGINAL EXTERIOR	ORIGINAL CORE	ORIGINAL INTERIOR	REFIRED EXTERIOR	REFIRED CORE	REFIRED INTERIOR
30	20	JR	COR	WQ	7.5R4/4 Weak Red	7.5R2.5/0 Blaek	7.5R4/4 Weak Red	10R4/6 Red	10R3/2 Dusky Red	10R4/6 Red
37	89	JB	COR	WQ	10R4/4 Weak Red	10R4/1 Dark Reddish Gray	10R4/1 Dark Reddish Gray	10R4/6 Red	10R4/2 Weak Red	10R4/2 Weak Red
38	89	JB	COR	WQ	10R4/4 Weak Red	10R4/1 Dark Reddish Gray	10R4/1 Dark Reddish Gray	10R4/4 Weak Red	10R4/4 Weak Red	10R4/4 Weak Red
39	89	JB	PL	WQ	10R5/6 Red	10R4/2 Weak Red	10R4/2 Weak Red	10R4/6 Red	10R4/4 Weak Red	10R4/4 Weak Red
20	106	JB	COR	Q	7.5R4/0 Dark Gray	7.5R4/0 Dark Gray	7.5R4/0 Dark Gray	10R3/2 Dusky Red	10R4/6 Red	10R4/6 Red
9	106	JB	COR	QSH	2.5YR5/2 Weak Red	2.5YR5/2 Weak Red	2.5YR4/1 Dark Reddish Gray	10R4/6 Red	10R4/8 Red	10R4/8 Red
27	45	JB	COR	Q	2.5YR4/4 Reddish Brown	2.5YR4/1 Dark Reddish Gray	2.5YR4/1 Dark Reddish Gray	10R5/6 Red	10R5/6 Red	10R5/6 Red
21	99	BB	B/SL	WQ	5YR5/3 Reddish Brown	5YR5/3 Reddish Brown	5YR5/3Reddish Brown	10R5/6 Red	10R5/6 Red	10R5/6 Red
33	31	JB	COR	Q	10R5/4 Weak Red	10R5/1 Reddish Gray	10R5/1 Reddish Gray	10R5/6 Red	10R6/8 Light Red	10R6/8 Light Red
2	126	BB	B/RD	QSH	10R4/6 Red	10R5/1 Reddish Gray	10R4/6 Red	10R4/6 Red	10R5/8 Red	10R4/8 Red
3	126	BB	B/G?	WQ	2.5YR5/3 Reddish Brown	2.5YR5/1 Reddish Gray	2.5YR5/3 Reddish Brown	10R5/6 Red	10R6/8 Light Red	10R5/8 Red
11	126	JB	COR	Q	7.5R4/2 Weak Red	7.5R5/0 Gray	7.5R5/0 Gray	10R4/6 Red	10R6/8 Light Red	10R5/8 Red
4	106	JB	COR	WQ	10R5/8 Red	GLEY 5/ Gray	GLEY 5/ Gray	10R5/6 Red	2.5YR5/4 Reddish Brown	2.5YR5/4 Reddish Brown
28	45	JB	PL	Q	5YR5/3 Reddish Brown	5YR6/1 Gray	5YR5/3 Reddish Brown	2.5YR5/8 Red	2.5YR5/4 Reddish Brown	2.5YR5/6 Red
19	126	JB	COR	Q	2.5YR4/1 Dark Reddish Gray	2.5YR5/1 Reddish Gray	2.5YR5/1 Reddish Gray	2.5YR5/8 Red	2.5YR5/6 Red	2.5YR5/6 Red
18	126	JB	COR	Q	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR5/1 Reddish Gray	2.5YR4/6 Red	2.5YR5/6 Red	2.5YR4/8 Red
6	106	JB	COR	WQ	2.5YR7/1 Light Reddish Gray	2.5YR6/4 Light Reddish Brown	2.5YR7/1 Light Reddish Gray	2.5YR6/6 Light Red	2.5YR6/6 Light Red	2.5YR6/6 Light Red
15	126	BB	PL	WQ	GLEY7/ Light Gray	GLEY 7/ Light Gray	GLEY 7/ Light Gray	2.5YR6/6 Light Red	2.5YR6/6 Light Red	2.5YR6/6 Light Red
1	126	BR	B/RD	Q	10R4/8 Red	GLEY 8/ White	10R4/8 Red	10R4/6 Red	2.5YR6/6 Light Red	10R4/8 Red
7	106	JB	COR	Q	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR6/8 Light Red	2.5YR6/8 Light Red	2.5YR6/8 Light Red
12	126	JB	COR	Q	2.5YR5/2 Weak Red	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR5/6 Red	2.5YR6/8 Light Red	2.5YR6/8 Light Red

Table 6.2. Re-fired sherd sample from 42Ka3976 (Munsell Soil Color Charts 1994 revised edition).

16	126	JB	PL	Q	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR6/8 Light Red	2.5YR6/8 Light Red	2.5YR6/8 Light Red
29	20	JR	COR	WQ	5YR6/2 Pinkish Gray	5YR6/1 Gray	5YR6/2 Pinkish Gray	2.5YR6/8 Light Red	2.5YR6/8 Light Red	2.5YR6/8 Light Red
17	126	JB	COR	WQSH	2.5YR6/4 Light Reddish Brown	GLEY 6/ Gray	GLEY 6/ Gray	2.5YR7/4 Light Reddish Brown	2.5YR7/3 Light Reddish Brown	2.5YR7/3 Light Reddish Brown
14	106	JB	PL	Q	GLEY7/ Light Gray	GLEY 7/ Light Gray	GLEY 7/ Light Gray	2.5YR7/4 Light Reddish Brown	2.5YR7/4 Light Reddish Brown	2.5YR7/4 Light Reddish Brown
13	106	JB	B/W	WQ	2.5YR7/1 Light Reddish Gray	2.5YR7/1 Light Reddish Gray	2.5YR7/1 Light Reddish Gray	2.5YR7/6 Light Red	2.5YR7/6 Light Red	2.5YR7/6 Light Red
36	89	JB	COR	WQ	5YR6/2 Pinkish Gray	5YR7/1 Light Gray	5YR7/1 Light Gray	2.5YR7/6 Light Red	2.5YR7/6 Light Red	2.5YR7/6 Light Red
10	126	JB	COR	Q	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR4/1 Dark Reddish Gray	2.5YR7/8 Light Red	2.5YR7/8 Light Red	2.5YR7/8 Light Red
22	99	BR	B/SL/COR	Q	2.5YR6/1 Reddish Gray	2.5YR6/6 Light Red	2.5YR6/6 Light Red	2.5YR7/8 Light Red	2.5YR7/8 Light Red	2.5YR7/8 Light Red
41	89	JB	COR	QSH	2.5YR6/1 Pale Red	2.5YR6/1 Reddish Gray	2.5YR6/2 Pale Red	7.5YR8/6 Reddish Yellow	2.5YR8/4 Pink	2.5YR8/4 Pink
5	106	JB	COR	WQSH	10R5/8 Red	GLEY 6/ Gray	GLEY 6/ Gray	10R6/6 Light Red	5YR5/4 Reddish Brown	5YR5/4 Reddish Brown
40	89	JB	COR	WQ	10R6/3 Pale Red	GLEY 6/ Gray	GLEY 6/ Gray	10R6/4 Pale Red	5YR6/1 Gray	5YR6/1 Gray
32	31	JB	PL	WQ	10R5/4 Weak Red	5YR5/1 Gray	5YR5/1 Gray	10R5/6 Red	5YR6/4 Light Reddish Brown	5YR6/3 Light Reddish Brown
25	45	JB	COR	Q	5YR6/3 Light Reddish Brown	5YR8/1 White	5YR8/1 White	5YR6/8 Reddish Yellow	5YR6/8 Reddish Yellow	5YR6/8 Reddish Yellow
8	126	JB	PL	Q	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	2.5YR6/1 Reddish Gray	5YR7/4 Pink	5YR7/4 Pink	5YR7/4 Pink
35	89	JB	COR	Q	10YR6/3 Pale Brown	10YR6/3 Pale Brown	10YR6/3 Pale Brown	5YR7/6 Reddish Yellow	5YR7/6 Reddish Yellow	5YR7/6 Reddish Yellow
26	45	JR	COR	WQ	GLEY7/ Light Gray	GLEY 7/ Light Gray	GLEY 7/ Light Gray	5YR7/6 Reddish Yellow	5YR7/6 Reddish Yellow	5YR7/6 Reddish Yellow
31	31	JR	COR	WQ	5YR7/1 Light Gray	5YR7/1 Light Gray	5YR7/1 Light Gray	5YR7/6 Reddish Yellow	5YR7/8 Reddish Yellow	5YR7/8 Reddish Yellow
34	31	JB	PL	Q	GLEY7/ Light Gray	GLEY 7/ Light Gray	GLEY 7/ Light Gray	7/5YR8/3 Pink	7.5YR8/3 Pink	7.5YR8/3 Pink
24	106	BR	B/ COR	Q	GLEY8/ White	GLEY 8/ White	GLEY 8/ White	7.5YR8/2 Pinkish White	7.5YR8/2 Pinkish White	7.5YR8/2 Pinkish White
23	99	BB	B/W	SH	GLEY8/ White	GLEY 8/ White	GLEY 8/ White	7.5YR8/4 Pink	7.5YR8/4 Pink	7.5YR8/4 Pink

Codes for Table 6.2. VF-Vessel Form: J_-Jar, B_-Bowl, _R-Rim, _B-Body; ST-Surface Treatment: PL-Plain, COR-Corrugated, B-Black-on-gray/white, SL-Slipped, RD-Red ware; T-Temper: Q-Quartz, WQ-White coated quartz, SH-Sherd.

Table 6.2 (continued). Re-fired sherd sample from 42Ka3976 (Munsell Soil Color Charts 1994 revised edition).

and have other characteristics that set them apart from the majority of the sherds.

The majority of the sherds that range in colorings and shades re-fired to a wide range of colorings and shades. This includes sherds originally described as having light and medium shades of clay, including two sherds originally described as "classic Shinarump". These sherds have a variety of the temper types found at the site along with different surface treatments. Both black-and-white and black-on-red sherds are mixed in with the re-fired color groupings of the plain and corrugated sherds. One gray sherd with a red granular coating on the exterior surface and a band of the same coating on the interior surface re-fired to a polychrome sherd with a band of black painted outlines filled in with red. The ranges in colors suggest that a variety of clay sources were used for this pottery. These re-firing results also indicate that similar clay sources were used for plain, corrugated, painted and red pottery at this site.

After re-firing, sherd temper not previously seen was noted in minor amounts in several sherds. The sherd temper appeared a bit darker after re-firing than the surrounding clay making it more visible. In many of the corrugated sherds, the exterior surface and the core are distinctly divided. This remained so as the two parts re-fired differently, too. These sherds were the ones most difficult to place into clay categories since they have overlapping characteristics in one sherd. The slip on the three painted sherds with different core colors fired to reddish-yellow (1-7.5YR7/6; 2-5YR7/6). The clay used for the slip may have been selected for common characteristics. The paint on all of the re-fired sherds, with the exception of one sherd, remained after re-firing indicating a mineral based paint.

Results of Analysis

A total of 13,774 pot sherds were collected from 42Ka3976 with 7,699 of these sherds analyzed as proposed. The total number of pot sherds include 9,720 (70.6%) corrugated, 1,631 (11.8%) plain, 1,883 (13.7%) painted, 527 (3.8%) red ware, and 13 (0.1%) indeterminate plain or corrugated sherds. All of the red wares and painted sherds were microscopically analyzed along with 46.6% (7,699) of the plain and corrugated sherds. The results are presented with the sherds grouped by surface treatments including summaries of the characteristics found in the pottery and the application of known pottery types.

Plain and Corrugated Pottery

Undecorated plain and corrugated pot sherds were sampled and analyzed together with the surface treatment coding used to distinguish the two kinds.

Surface Treatment. The largest majority (85.6%) of the gray ware sherds from 42Ka3976 have corrugated exterior surfaces. The corrugation patterns were separated into indented and unindented corrugation with this division seeming unnecessary later in analysis. Although most corrugated sherds display either one or the other pattern, both indented and unindented patterns were found on many individual sherds. These texture differences were even used to make alternating diamond shaped patterns on some vessels. The coil widths between the two patterns did not seem to vary and the corrugation was rarely obliterated. The surfaces of 42% of the plain sherds analyzed have remnants of a fugitive red coating on the exterior surfaces. This coating was found on both light colored and dark colored surfaces. In some instances, fugitive red seems to be mixed in with the exterior of some of the darker fired corrugated sherds. Perhaps this served to enhance a "redder" coloring of the pottery. A small group of plain jar sherds have a rough exterior surface a bit lighter in color than the clay body. It looks as though the surface was only roughly smoothed rather than completely smoothed like the other plain sherds. These sherds may all be from the same vessel. Another group of jar sherds have the very light white colored clay more often seen in painted pottery with deep scrape marks and no paint. These also are most likely from the same vessel.

Clay. The clay in the plain and corrugated pottery from 42Ka3976 is mostly consistent in texture as a medium to medium coarse clay. The smaller number of sherds with a finer clay are easily distinguished. Although not specifically part of the analysis, it was noticed that many sherds have different degrees of vitrification between the clay starting to look "melted" to being very "glassy". In some sherds, only the exterior margin appears vitrified. This is especially evident in sherds with very dark reddish exterior coloring where the clay along the exterior margin appears completely smooth (melted). The

colorings of the clay vary greatly through shades of gray, brown and red with variability often seen in individual sherds. This variability in individual sherds is most likely due to uneven firing conditions resulting in different exterior and interior colors/ shades. In many sherds, a very dark exterior contrasts to a much lighter interior surface. Even separating the clay into light, medium and dark was sometimes difficult because of this. The percentages of clay shadings in the plain and corrugated pottery are as follows: light-12.86%; medium-64.70%; and dark-22.44% (shown in Table 6.3 with temper categories). Underfired sherds with black cores or interiors were not found.

Temper. All but a small percentage of the plain and corrugated sherds contain quartz temper. There is variation within the quartz temper used with the largest percentage (95.33%) of sherds containing quartz that is most likely from a sandstone source. Two groups of this temper are defined for these sherds. The first group consists of white-coated quartz, primarily well- to poorly-sorted with subrounded to angular grains measuring up to 1.0mm in diameter. Sandstone grains are sometimes present showing the angularity and size of the individual quartz grains with a white cementing matrix. The quartz temper (Quartz 1) observed most often contains the same white-coated quartz along with other quartz grains that lack the white coating. Sorting, angularity and size of quartz grains are similar in both groups. Neither clear quartz nor well-rounded quartz grains are common. Also present in minor amounts are sherd temper, unidentified soft white fragments, unground clay, and assorted other dark grains. The sherd temper appears to be from these same kinds of sherds with the darker colored sherd temper most easily identified. Smooth brick red fragments are actually sherd temper from the dark vitrified portions, usually the exterior margins, of other utility sherds.

A smaller percentage (1.42%) of plain and corrugated sherds has sherd temper or sherd temper plus quartz. These sherds most likely belong with the larger previously mentioned group with varying percentages of similar temper composition. The sherd temper has assorted colorings with quartz temper similar to the majority of the plain and corrugated sherds at this site. This temper division may just be a result of the break examined having a higher percentage of sherd than quartz. Clay characteristics and surface treatments support this conclusion.

A quartz sand temper (Quartz 2) containing more variety in angularity is found in 2.61% of the

42Ka3976-Temper and Clay in Corrugated & Plain Sherds				
	Clay			
Temper	Light	Medium	Dark	Total
Olivine	1	1	0	2
Sherd/Olivine	0	2	5	7
White Quartz	126	444	327	897
Quartz1	514	2794	837	4145
Quartz2	30	97	10	137
Quartz3	0	0	1	1
Quartz/Sherd	3	57	4	64
Sherd	2	9	0	11
None	0	11	1	12
Other	4	7	2	13
Total	680	3422	1187	5289

Table 6.3. Temper types and clay shadings in corrugated and plain potsherds from 42Ka3976.

plain and corrugated sherds from 42Ka3976. This temper does not contain white-coated quartz or sandstone fragments. The source of this temper appears to be different than that used in the majority of the sherds. A single plain sherd contains very well-sorted, tiny quartz sand (Quartz 3) that is also found mainly in some of the painted pottery. This sherd is probably from a painted vessel. No corrugated sherds have this fine quartz temper.

Two plain sherds have olivine temper. These sherds may be from the same vessel. Five plain sherds and two corrugated sherds have sherd temper plus olivine. This sherd temper contains quartz and/or olivine and does not have the same colorings as the sherd temper found in the larger group of sherds.

Twelve of the analyzed sherds have no temper. They are made from what looks more like "fired mud" without added non-plastics than with the clay and added temper of the majority of the sherds. A smaller number of sherds (0.23%) contain unidentified temper.

Vessel Forms. Jar and bowl distinctions were made based on rim curvatures and overall surface finishing. With the exception of one bowl rim sherd, all of the unpainted corrugated sherds are from jars. The plain sherds represent both jars and bowls. A ratio of 1 bowl sherd to 111 jar sherds can be calculated for the analyzed sherds demonstrating the overwhelming presence of jars in the undecorated category. The amount of eversion on the rim sherds analyzed varies: none (A)-1.8%; slight (B)-14.8%; more (C)-69.7%; and strong (D)-13.7%. The small percentage of vessels with no eversion is reflected in the small number of bowls, although a couple of jar rims demonstrate no eversion. One of the non-tempered bowl rims, a miniature vessel, is inverted. The total number of worked sherds does not include those worked sherds pulled from the collection previous to this analysis. Various miniature vessels, jars and bowls, are represented by the non-tempered "fired mud" sherds.

Pottery Types. A very high percentage of these analyzed plain and corrugated sherds contain a temper from the same or a similar source. This group includes the sherds with white-coated quartz, white-coated quartz and quartz, quartz/sherd, and sherd temper. The clay in these sherds is similar in texture but variable in shading and coloring. Clay shading varies from light (12.6%) to medium (64.6%) to dark (22.8%). A gradation from the light through medium to dark shadings is present. The amount of vitrification also varies within and across each shade. This presents a problem in assigning these sherds to a previously defined type. The darker colored sherds and many of the medium colored sherds would most likely be considered Shinarump types. The lighter colored and the remainder of the medium colored sherds would most likely be considered to be a Tusayan Gray Ware type-either Virgin or Kayenta series. The medium colored sherds alone include such a wide range that legitimately separating this group into Shinarump and non-Shinarump, as currently defined, would be impossible. The re-fired sample of sherds also supports this since the resultant colors are also variable. At 42Ka3976, this large group of sherds with similar material composition will be considered to be locally made and a current type name will not be assigned. Specific clay sources vary as indicated through the re-firing test with the clays used having variable amounts of iron. The temper source seems to be more consistent. The sherds with no temper from miniature vessels are also considered to be locally made with different materials.

The smaller percentage of sherds (2.9%) with quartz sand temper and unidentified temper are considered to be Virgin or Kayenta Anasazi made and fall within the Tusayan Gray Ware group. The majority of these sherds have lighter to medium clay with most of the dark sherds being burnt. The clay in most of these sherds is also finer in texture than in the larger group of sherds. Assigning these sherds to a particular type is difficult because of the subtle differences between Virgin and Kayenta gray ware types. When working with a few sherds, it is difficult to determine the ranges of allowable temper characteristics in defined plain types. Even the plain sherds cannot be assigned to one series or another with the other indications that this site is of a late time period allowing for the presence of plain Kayenta gray wares (Ambler 1985:51-52).

The two olivine tempered sherds are Moapa Gray Ware, Boulder Gray, and are most likely from the same vessel. The seven sherds with sherd temper and a few free olivine grains have the coarse, darker clay of Shivwits Plain.

Black-on-gray/white pottery

The painted pottery was analyzed along with

the plain/corrugated pottery to allow for more direct visual comparisons of material composition. Painted design elements were also recorded and used to assign design styles with corresponding dating when possible.

Surface Treatment. The painted pottery is distinguished by black paint on either plain surfaces or slipped surfaces found on the interior surfaces of bowls and the exteriors of jars. The construction methods are the same as those found in the unpainted pottery with generally smoothed surfaces. The corrugation found on some (about 10%) painted pottery appears only on the exterior surfaces of bowls with the paint on the smoother interior surfaces. Often, the coils in the painted corrugated pottery are thinner with "pinched" indentations more closely spaced than those of the undecorated corrugated pottery. It could not be determined through this analysis if thinner coils were used to make painted as opposed to unpainted pottery. No obvious differences in wall widths were noticed.

A large majority of the painted sherds (94.1%) have a slip applied over the clay body before firing. The slip is distinguished by being a different color than the clay body and lacking temper although the temper of the body sometimes protrudes through the slip. The coloring of the slip is consistently a cream color with fewer sherds having a very white slip. The slip on three painted sherds, one of which is corrugated, tested during re-firing have the same re-fired colors even though the clay body colors vary. The slip on most of these sherds varies in thickness from being very thin and sometimes almost imperceptible to being very thick. Fine cracks and spot peeling are common. This cream colored slip is found on both surfaces of the sherds, including the corrugated exterior of painted/corrugated sherds. Fewer sherds have a very white slip found on the interior surfaces of bowls and the exterior surfaces of jars. Fugitive red was noted on only three painted sherds and may indicate mis-fired red wares (refer to the section on red wares).

The paint found on the majority of these sherds is heavy and bold with a few exceptions. Of the five painted sherds in the re-firing sample, the paint on only one of the sherds "disappeared" after re-firing. This indicates that the paint on that one sherd has an organic base burning off at the high temperature. This sherd also fired to a very light color and is considered to be intrusive to the site. The paint on the other re-fired sherds remained with no change and is mineral based. The paint on the majority of sherds from this site appears to be mineral based.

Clay. The clay in most of the painted sherds resembles the medium coarse clay observed in the plain/corrugated sherds. The same shading categories were used for the painted sherds with a noticeable shift to lighter clay colors: 26.5% light, 53.8% medium, and 19.3% dark. The remaining percentage of sherds contains very light, almost white, clay found only in painted sherds. The cream colored slip was applied to light, medium and dark clays. A smaller group of sherds have finer textured clay with most of these in the white to light and medium gray color shading groups. Some of these sherds have a dark core with light margins and occasionally a white slip.

Temper. The temper in the painted sherds is also primarily very similar to that in the plain/corrugated sherds (Table 6.4). The largest majority of sherds (84.5%) contain a temper that includes white coated quartz. The quartz sand temper (Quartz 2) is also present in a smaller percentage of sherds. The quartz/sherd and sherd temper of the painted sherds is the same as in the plain/corrugated sherds. One noticeable difference in tempers between the painted and plain/corrugated sherds is the higher number of painted sherds with a sparse, well-sorted, tiny quartz temper (Quartz 3). Eight painted sherds have olivine temper. No painted sherds have sherd temper plus olivine. One sherd without temper made of the "fired mud" has a wide stripe of black paint.

Vessel Forms. Both bowls and jars are represented by the painted sherds from 42Ka3976. The largest number (90.3%) of the painted sherds are from bowls with a smaller number (9.7%) from jars. All but two of the painted bowl rims have no eversion. One of the other two bowl rims is slightly everted and the other is more everted. All ranges of eversion are represented by painted jar rim sherds. Twenty-nine worked bowl sherds and four worked jar sherds should be added to the separate totals of worked sherds.

Painted Designs. The design styles that could be identified on painted sherds from 42Ka3976 include Black Mesa (6.5%), Sosi (15.8%) and Dogoszhi (21.8%) styles. Most of the painted

42Ka3976-Temper in Painted Sherds						
Temper	**Local**	**Kayenta Series**	**Virgin Series**	**Unidentified Kayenta/Virgin**	**Moapa Series**	**Totals**
Olivine	0	0	0	0	8	8
White Quartz	331	0	0	0	0	331
Quartz1	1256	0	1	3	0	1260
Quartz2	91	0	9	38	0	138
Quartz3	0	57	0	51	0	108
Quartz/Sherd	23	0	0	4	0	27
Sherd	2	0	0	0	0	2
None	1	0	0	0	0	1
Other	0	0	1	7	0	8
Totals	1704	57	11	103	8	1883

Table 6.4. Temper types in painted potsherds from 42Ka3976.

designs on the sherds are only portions of the design. (Design styles and elements are presented in Table 6.5). Most of these elements are lines in sizes ranging from fine to wide with various sizes often present on single sherds. Initial analysis used Allison's guidelines for line width as fine lines-2.5mm or less; narrow lines-mostly 3-4mm; and wide lines at least 5mm (1998:9-9, -10). A line width between these was consistently found on the 42Ka3976 sherds requiring a modification. Fine lines are defined as less than 2.5mm; narrow lines are 3-4mm; medium lines are 4-5mm; and wide lines are greater than 5mm in width. These line widths can be found in all three of the design styles mentioned above. It is suspected that most of the fine and narrow lines are actually portions of cross-hatched designs which most often incorporate these line widths. Most notable is the boldness and evenness of the painted lines.

Allison used the presence or absence of embellishments on solids in combination with line width to distinguish design patterns (1998). The analysis of painted sherds from 42Ka3976 also focused on these distinctions since they seem to be the "basics" used to determine design styles. Embellishments found on some of these sherds include pendant dots, ticks and occasional fringes on partial solids. Black Mesa style elements include primarily solid lines and triangles with pendant dots, ticks and barbs. Also included are a checkerboard pattern on seventeen sherds and opposing triangles connecting at their points forming open diamond patterns found on six sherds. Sosi designs found at 42Ka3976 include bold parallel and nesting lines, elongated triangles, triangles in series, and a step pattern. Solids found on sherds from 42Ka3976 consist in the most part of triangles, particularly elongated triangles found in corners of bent lines. These fit within the definition of Sosi style. Other triangles found as connecting in rows and opposing each other were placed into Sosi or Black Mesa styles based on the presence or absence of embellishments and accompanying line patterns. Cross-hatching of outlined shapes indicates a Dogoszhi design style. These shapes are mostly rectilinear with occasional curvilinear designs. Straight hatching has horizontal lines in relation to the outlined patterns and could probably be considered to be Dogoszhi style also.

Elements on fewer of the sherds were not identified to a specific style. The diamond and rectangle hatching patterns resemble a net drawn within an outlined shape. One bowl has corrugation on the exterior and a painted band running parallel to the rim on the interior with connecting rectangles and small solid rectangles painted in spaces. Dots are most often in rows and sometimes grouped looking like they filled in an outlined shape. The accompanying partial lines and solids have even edges and do not appear to fall within the early Lino design style. The flagged cross is unique to one sherd

42Ka3976-Painted Design Elements on Sherds						
Design Style/Element	**Local**	**Kayenta Series**	**Virgin Series**	**Unidentified Kayenta/Virgin**	**Moapa Series**	**Totals**
Black Mesa Style	69	39	0	15	0	123
Sosi Style	279	0	0	15	3	297
Dogoszhi Style	397	4	5	5	0	411
Fine Lines	31	0	0	1	1	33
Fine & Narrow Lines	10	0	1	1	0	12
Fine & Medium Lines	3	0	0	0	0	3
Fine & Wide Lines	0	0	0	1	0	1
Narrow Lines	157	1	5	2	2	167
Narrow & Medium Lines	23	0	0	2	0	25
Narrow & Wide Lines	11	0	0	0	0	11
Medium Lines	167	0	0	11	0	178
Medium & Wide Lines	20	0	0	6	0	26
Wide Lines	156	8	0	17	0	181
Straight Hatching	46	0	0	2	0	48
Diamond Hatching	7	0	0	0	0	7
Rectangle Hatching	6	0	0	1	0	7
Triangles & Rectangles	5	0	0	0	0	5
Dots	18	1	0	0	0	19
Flagged Cross	1	0	0	0	0	1
Unidentifiable	298	4	0	24	2	328
Totals	1704	57	11	103	8	1883

Table 6.5. Design styles and elemest on painted potsherds from 42Ka3976.

and is a cross with small bent triangles on each end facing the same direction. The unidentifiable group contains sherds with small indiscernible painted elements and a few sherds that have no paint but come from painted vessels (i.e. have a slip). Table 6.5 lists the sherd counts of these elements without identification as particular design styles.

Most of the design elements on painted sherds from 42Ka3976 fall within Black Mesa, Sosi and Dogoszhi design style descriptions. Earlier design styles are not present. Some of the elements fit within descriptions of later design styles (Colton and Hargrave 1937:226-231) but none of these sherds have enough of the design present to definitely place them in one style or another. For example, the diagonal or rectangular cross-hatching (net patterns) and dots in open squares fall within Flagstaff style but the sherds from 42Ka3976 lack the more characteristic barbed lines of this style. Rows of dots and free solid squares also are described in some later styles. The designs on the sherds from 42Ka3976 are "spacey" and do not have the heavy usage of paint often described in later styles. A negative design effect with more painted surface than unpainted surface is not found here. Designs appear to be mostly in the form of bands around and parallel to bowl rims.

Pottery Types. At 42Ka3976, the largest number of painted sherds (90.5%) has similar temper and clay comparable to the majority of

the plain/corrugated pottery from this site. These painted sherds are slipped with finer cream colored clay over both surfaces. The range in the clay body shadings from light to dark in these sherds presents the same problem in type assignment as with the plain/corrugated sherds. Shinarump painted types include Virgin Black-on-white and Toquerville Black-on-white (with corrugation) without further design style divisions (Colton 1952:63-65). Based on this and Lyneis' (1998) descriptions of Shinarump pottery, only some of these sherds could be defined as Shinarump. Because of the similarities in clays and temper types in this large group of painted pottery, it does not make sense to separate them into particular types. This group of painted pottery was made using the same materials as the plain and corrugated pottery indicating a similar source of production and again indicating that they are locally made. Design elements and styles fall within the full range of observed patterns listed in Table 6.5 and previously discussed.

Painted sherds that are intrusive to this site (9.5%) include both Virgin and Kayenta Anasazi types. There are some characteristics that can be used to separate Virgin and Kayenta white wares. The painted sherds from this site placed into the Kayenta Series have a very fine tiny quartz temper in clay with a dark core that fired white on the margins and surfaces. Approximately half of these sherds have a white slip. Most of these sherds are Black Mesa Black-on-white. A few of the sherds can be identified as Dogoszhi Black-on-white. The rest of the Kayenta Series black-on-white sherds have wide lines, narrow lines, dots or are unidentifiable to style/element. The painted sherds identified as Virgin Series have gray clay without a slip with a moderately sorted medium quartz sand temper. Most of these sherds are Hildale Black-on-gray with a Dogoszhi design style. The rest of these sherds have fine to narrow lines and may also be from Hildale Black-on-gray vessels. Most of the intrusive sherds are placed in an unidentified Kayenta/Virgin Anasazi painted category since they are not distinctive enough to confidently place them in one or the other series. This includes both plain and corrugated painted sherds and sherds with and without a slip. These sherds have similar painted design styles as the local painted pottery including Black Mesa, Sosi and Dogoszhi design styles with the rest of the sherds having painted lines in various widths.

Eight painted sherds are Virgin Anasazi Moapa Gray Ware sherds from north of the Grand Canyon. Three of these sherds, probably from the same vessel, are Moapa Black-on-gray with a Sosi design style. Three of the sherds have portions of lines and the other two sherds have portions of unidentifiable designs. It is possible that all of these sherds are from the same vessel.

Red Ware Pottery

The red ware pot sherds from 42Ka3976 were all analyzed together with the smaller number of these sherds allowing for more direct comparisons between them. Red ware sherds from this site are plain (44.4%), black-on-red (49.7%) and polychrome (5.9%).

Surface Treatment. Red wares are so named because of their red colored surfaces. The surfaces on many of the red ware sherds from 42Ka3976 look as though a red granular wash was applied before firing leaving a coating on the surface. This coating is different in texture, and coloring, than the clay used as a slip applied to black-on-white pottery. Many of these sherds are not well-polished leaving the red coating grainy-looking and often streaky while fewer of these sherds are very well-polished. The streaking, mostly on exterior surfaces, sometimes looks like reddish paint. Bowl sherds have the coating on both surfaces while jars tend to have the coating on the exterior only. Many of the polychrome bowl sherds have the red coating on the exterior surface with the red used only as "paint" on the interior surface. This leaves a duller, uncoated interior surface with black painted line outlines filled in with the red granular coating. Munsell color chart readings are the same for the exterior surface coating as for the interior red "paint". A majority of the red ware sherds (94.6%) have this coating while fewer of the sherds (7.4%) do not. In some cases, the red ware sherds without the red coating may have originally had the coating which may have worn off. The black paint on the painted red wares is sometimes heavy and sometimes very faded on both black-on-reds and polychromes. The red paint on the polychrome sherds sometimes is grainy looking and sometimes looks more like red paint. Polychrome paint colors include black and red only.

Clay. The clay used in making red wares fires to the red color. Most of the red wares are fired throughout the sherd with no core. Fewer sherds have reddish-orange surfaces and margins with a darker gray core. The colorings of the surfaces vary from a reddish purple to red to reddish orange. Several dark gray sherds with black paint and reddish coatings and paint are believed to be "mis-fired" red ware. When re-fired to 900-degrees Celsius, one such sherd fired to a polychrome sherd with black outlines and reddish fill-in. Occasionally gray ware sherds fire to reddish colors often with a subtle distinction in coloring. This may lead to some sherds falling into incorrect categories but the actual numbers are probably small enough to not be of much concern.

Temper. The temper found in most of the red ware sherds from 42Ka3976 have quartz and sherd fragments. These sherd temper fragments have the same coloring seen in the majority of the plain and corrugated sherds from this site. The colorings range from dark reds, browns, and grays in contrast to the lighter colored sherd temper found in the predominantly sherd tempered red wares. Very smooth brick red fragments that appear in these red wares are like the vitrified dark exterior surfaces of corrugated sherds from this site. Similar sherd temper was observed in lesser amounts in some plain and corrugated sherds.

Sherd temper is found in 26.4% of the red wares at this site. Most of this sherd temper is white and/or light gray in color and is most visible in the margins or on the surfaces of the sherds. Quartz and other assorted grains are present in lesser amounts. A few of these sherds have the color variety in the sherd temper as previously described with quartz in very minor amounts. These sherds could belong to the previously described quartz/sherd temper with the kind of temper observed based on the location of the break on the sherd revealing different proportions of temper composition.

A smaller percentage of the red wares (10.2%) have similar quartz temper to those found in the undecorated and the painted sherds at this site. The quartz temper includes some white-coated quartz along with the other characteristics defined for Quartz 1 and Quartz 2 temper. Darker sherd fragments are sometimes present in minor amounts.

Vessel Form. Most of the red ware sherds from 42Ka3976 are from bowls (79.1%) with fewer sherds from jars (20.5%) and a few indeterminate body sherds. About one-third of the bowl sherds are rims with no eversion. The jar rim sherds have both no eversion and a slight eversion. The worked red ware bowl and jar sherds should be included in the separate group of worked sherds.

Painted Designs. The same design element classification used for the painted pottery was used for the red wares with the addition of two polychrome categories (Table 6.6). The designs on these red wares consist of lines in different sizes and hatched elements without solid shapes or embellishments. The largest majority of painted red ware sherds have the cross-hatching of Dogoszhi style. The narrow lines found on other sherds may also be portions of cross-hatching. Most of the polychrome designs consist of a very wide band outlined in black paint with a red fill in. Some of these bands have black painted cross-hatching over the red paint.

Pottery Types. The majority of the red ware sherds from 42Ka3976 have quartz and multiple colored sherd temper. These sherds and the sherds with quartz sand temper are most likely locally made. This group of red wares fits closely into the sand-tempered red ware group more recently reported by several researchers in the Virgin Anasazi region. Lyneis identified "rusty to dark gray or black" colored grains in sand-tempered red ware as sherd temper (1992:55). This is consistent with the sherd temper observed in the 42Ka3976 red wares. Thompson reports on slipped sand-tempered red ware sherds, some of which had the slip rubbed off in cleaning (Walling et al. 1986:360-361). This slip may be similar to the red wash found on the sherds from 42Ka3976. In that report, Thompson suggested using Kanab Red, Kanab Black-on-red, and Kanab Polychrome for this kind of red ware (Walling et al. 1986:361). Lyneis supports the usage of these names and proposes including them under Shinarump Red Ware (1998:23). Most of the red wares from 42Ka3976 fit into this proposed classification with the modification of adding variable sherd temper to the definition. Further division by design styles and dating of this pottery has not been defined yet. The majority of painted red wares from 42Ka3976 have a Dogoszhi style. These red ware sherds fit more readily into a Shinarump type than the plain/corrugated and painted sherds from this site but will

42Ka3976-Design Elements on Red Ware Sherds			
Design Elements	**Local**	**Tsegi**	**Totals**
Sosi	5	6	11
Dogoszhi	98	39	137
Fine Lines	1	1	2
Fine & Narrow Lines	1	0	1
Fine & Wide Lines	0	1	1
Narrow Lines	37	2	39
Narrow & Wide Lines	3	2	5
Medium Lines	3	4	7
Medium & Wide Lines	1	0	1
Wide Lines	7	2	9
Straight Hatching	24	1	25
Indeterminate	13	11	24
None	184	51	235
Polychrome Black Outline/Red Fill-In	20	4	24
Polychrome Cross-Hatched	1	5	6
Totals	398	129	527

Table 6.6. Design styles and elements on Red Ware potsherds from 42Ka3976.

still be considered as locally made pottery without specific type names.

Tsegi Orange Ware is recognized as having sherd temper that is most often visible in contrast to the gray core and in worn portions of the surfaces (Lyneis 1992:54). This sherd temper usually appears as white fragments from white ware with lesser quantities of gray and red ware sherd fragments, quartz grains, and a few other mineral fragments (Lyneis 1992:54). The presence or absence of a slip does not help in the separation of locally made red wares from Tsegi Orange since both groups contain some of each with the slipped sherds being much more abundant. The slip on the Tsegi Orange sherds also often looks granular but more highly polished. There are subtle clay coloring distinctions but these tend to overlap from one group to the other at times. A lesser percentage (24.5%) of the red wares from 42Ka3976 is Tsegi Orange Ware. This includes Medicine Black-on-red with painted lines of various widths, Tusayan Black-on-red with hatchures, and Citadel Polychrome with black and red paint. Many sherds have no paint but may be from the unpainted portions of a painted vessel. The largest majority of Tsegi Orange Ware sherds from 42Ka3976 have either no paint or a Dogoszhi style.

Whole and Reconstructed Vessels

Eleven whole and mostly reconstructable vessels were collected from the Arroyo site (Figs. 6.1, 6.2) Seven of these vessels are black-on-white bowls; two vessels are corrugated jars; one vessel is a painted jar; and one vessel is a black-on-red bowl. These vessels were examined after the sherd analysis was completed. Some of the whole vessels had no breaks making them difficult to examine. Based on the materials used and the overall appearances of these vessels, ten of them fit within locally made descriptions and one is non-local.

Corrugated Vessels. Two corrugated jars were collected from Burial 3 located in the fill of PS-1 (Fig. 6.2). One jar is a small mug sized vessel with a handle on one side and a portion of its lip bent outward, perhaps for pouring. This globular shaped vessel measures 14.2 cm high with an inner

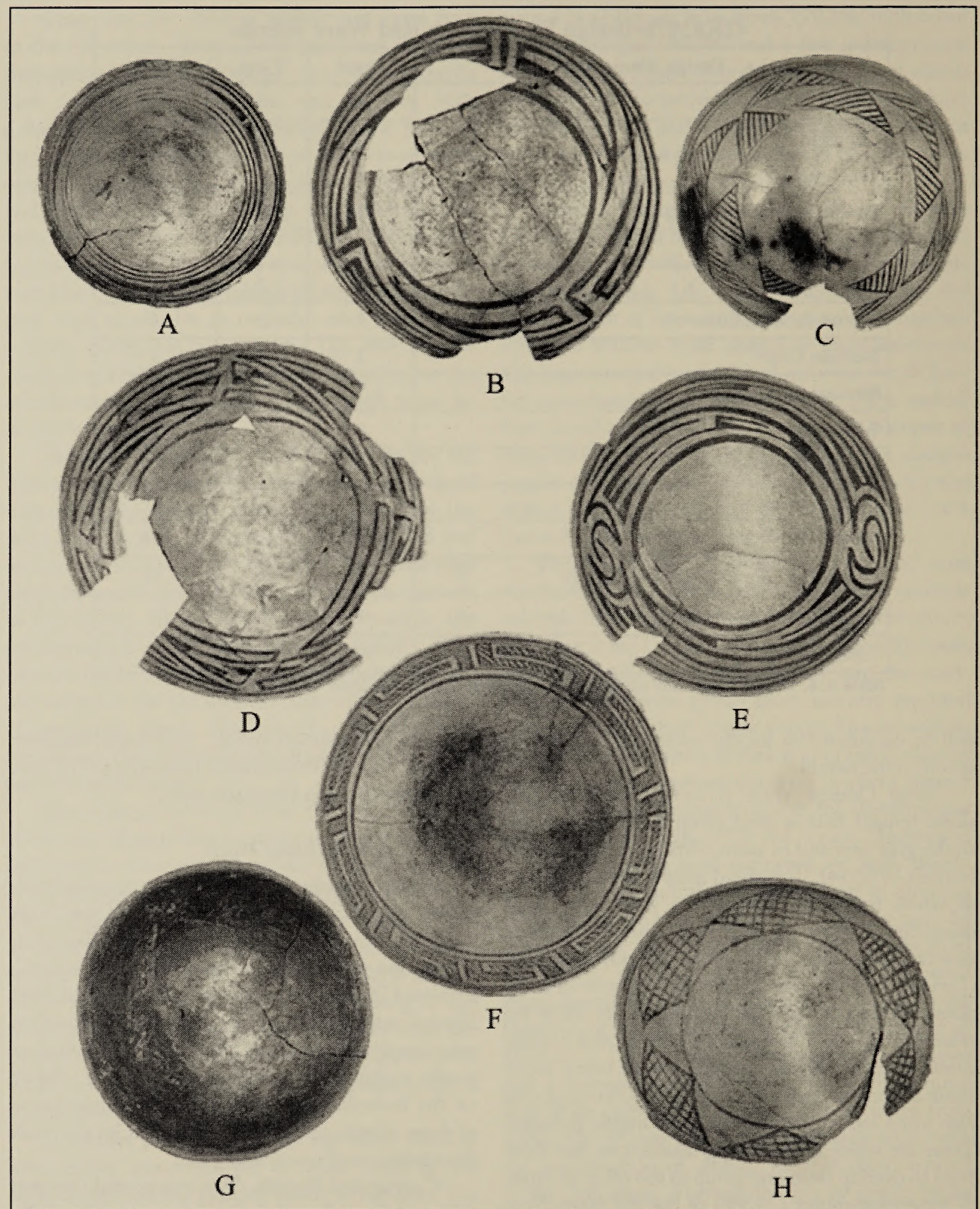


Figure 6.1. Intact and restored bowls, vessel type and diameter: (A) WygaretB/G, 13.7 cm; (B) Wyaret B/G, 21.4 cm; (C) Orderville B/W, 15.6 cm; (D) North Creek B/G, 24 cm; (E) North Creek B/G, 20 cm; (F) Hildale B/G, 24 cm; (G) Middleton Red (Shinarump), 16.4 cm; (H) Wahweap B/G, 17 cm.

Figure 6.2. Intact jars, vessel type: (A) Local Corrugated Canteen; (B) Local Corrugated jar; (C) Unidentified B/G Mug.

orifice diameter of 10.6 cm. The jar is made of dark brownish gray clay with a purple tint tempered with quartz and crushed sherd. There is no applied slip. The corrugated exterior surface is indented. This small vessel falls within locally made pottery for 42Ka3976.

The other corrugated vessel is a miniature canteen-like jar with two pierced lug handles. This vessel measures 9.9 cm high with a very narrow orifice of 2.5 cm. There are no fresh breaks for viewing material composition but the clay is gray with some quartz grains visible. The exterior surface consists of narrow flattened, overlapping coils without indentations. This miniature jar probably was also locally made.

Black-on-white Vessels. The temper in six of the seven black-on-white bowls is consistent with the white quartz and mixed quartz tempers observed in the locally made painted sherds. Clay coloring and shading is also similar ranging from a silvery gray to medium gray and red. None of these vessels have the dark clay most often associated with Shinarump pottery. All of these bowls have a thin whitish slip that sometimes resembles a wash. Worn spots are present with the underlying clay body showing through. Although one of these vessels has red fired clay, it is considered to be a black-on-white vessel rather than red ware with the firing conditions causing the reddened coloring. The red coloring in this vessel is similar to red margins found in another painted vessel in this group. The temper and slipped finish are comparable to other black-on-white sherds and vessels from this site (Fig. 6.1A).

Four of the locally made black-on-white bowls have a Sosi Design Style (Fig. 6.1 A, B, D, E). These bowls are medium sized with orifice diameters of 13.7 cm, 21.4 cm, 20 cm, and 24.3 cm. One bowl has a band of large connecting outlined diamonds filled in with rectangular hatching (Fig. 6.1H). The orifice diameter of this bowl measures 17 cm. The last locally made black-on-white bowl has a Dogoszhi Design Style and measures 24.5 cm across (Fig. 6.1F).

One black-on-white bowl associated with the F40 surface and fill of PS-3 is made of fine white firing clay with well rounded quartz temper (Fig. 6.1C). The presence of a slip is difficult to see without a fresh break being made. The interior of the bowl has a painted band of two rows of staggered cross-hatched triangles outlined with a continuous line. The exterior of the vessel is a narrow indented corrugation. The construction materials differ from those of the majority of the sherds and vessels found at 42Ka3976 with this vessel more closely resembling Kayenta Anasazi black-on-white bowls.

One miniature painted globular jar was collected from the fill of PS-1, Burial 3 (Fig 6.2C). This vessel has a height of 8.1 cm with an inner orifice diameter of 5.9 cm. The surfaces and rim of the jar are not well-smoothed and formed as larger vessel

and sherds from larger vessels at this site. The vessel appears to be made with similar materials used in the majority of sherds with quartz temper and silvery gray fired clay. The jar has a very thin slip applied to its exterior surface and partly down into the interior surface. The painted design resembles the earliest Virgin and Kayenta Anasazi styles with uneven lines and free-standing dots filling in an irregularly outlined rectangle. Although this design style alone would generally indicate an early date, it is suspected that the painting has something to do with the overall making of this vessel. There is an overall sense that this vessel was not made precisely like the other vessels from the site but was made at the same time.

Red Ware Vessels. One red ware bowl with a 16.8 cm orifice diameter was found in the fill of PS-1, Burial 3 (Fig. 6.1G). This vessel is made of the same materials as locally made red wares from the site. The temper consists of variegated colored sherd and white coated quartz. There is no visible slip. There are remnants of what may be black paint on the interior surface but this is faded too much to see.

Site Dating From Pottery

Corrugated and Plain Pottery

Colton and Hargrave note corrugated pottery begins in Pueblo I times as neck banding in eastern Anasazi areas (1937:195). Corrugated vessels then almost replace plain vessels in the Kayenta region (Walling et al. 1986:356) with plain vessels returning after A.D.1200 (Ambler 1985:51-52). In the Virgin region, corrugated pottery makes an appearance around A.D.1050 and is used as an indicator for dating sites to mid and later Pueblo II times. Plain pottery continues to be used along with the corrugated pottery. The large percentage of corrugated sherds at 42Ka3976 place the site to post-A.D.1050 times. The dating of the plain sherds is too difficult to determine because of their presence through time without distinctive differences. The high number of rim sherds with strong eversions also suggest at least Pueblo II dates.

Painted Design Styles

A chronology of painted design styles has been developed through cross-dating with tree ring dates in the Kayenta Anasazi region (Breternitz et al. 1974; Ambler 1985; and Christenson 1994). The design styles follow those defined by Colton and Hargrave for the Kayenta Series of Tusayan White Ware (1937:203-231). These same design styles and dates are used for cross-dating in the Virgin Anasazi region which does not yet have its own well-dated design style chronology.

All of the painted pottery from 42Ka3976 appears to be either Kayenta or Virgin Anasazi made. The Kayenta design styles and corresponding dates are used to describe this pottery. The earliest design elements found on pottery from 42Ka3976 are Black Mesa style which is generally associated with Pueblo II (A.D.900-1160) dating. The Sosi design style dates from mid-Pueblo II into early Pueblo III (A.D.1050-1180) times. The Dogoszhi design style is characterized by cross-hatching in rectilinear and curvilinear panels. The horizontal straight hatching elements found at 42Ka3976 probably also fit into the Dogoszhi style. Dating for the Dogoszhi style (A.D.1040-1210) begins slightly earlier than and extends slightly later than the Sosi style. (The dates used here are from Ambler 1985 and Christenson 1994). The variety of line widths found on sherds without more of a design present to determine a style fall within the descriptive ranges found in these three design styles. Many of the fine and narrow lines may actually be portions of cross-hatching. The other elements of diamond hatching, rectangular hatching, and rows of free dots are defined in different styles defined by Colton and Hargrave as being found in the Pueblo III period (1937:226-231). The free dots on this pottery differ from free dots used to distinguish the very early Lino design style by their placement and by having portions of heavy solid elements present too.

The painted design elements on pottery from 42Ka3976 date from Pueblo II (A.D.900) into early Pueblo III (A.D.1210) times. With higher percentages of Sosi and Dogoszhi style elements present along with indications of even later styles, later dating is suggested placing 42Ka3976 into late Pueblo II and early Pueblo III times (A.D.1100-1200).

Red Wares

The majority of the red ware potsherds found at 42Ka3976 with a sand/sherd temper has yet to be

dated. The Tsegi Orange Ware types representing only 0.9% of the total assemblage at 42Ka3976 comes from the Kayenta area in northeastern Arizona. Medicine Black-on-red dates from A.D.1040-1200; Tusayan Black-on-red dates from A.D.1045-1240; and Citadel Polychrome dates from A.D.1040-1200 (Christenson 1992:305). Again, the higher percentages of the later dating design styles at 42Ka3976 indicates later dating with the red wares at this site indicating Pueblo II to early Pueblo III dates.

Overview of 42Ka3976 Ceramics

During analysis, the pottery was basically separated into plain/corrugated, painted and red ware sherds. All of this pottery combines to form the overall vessel assemblage representing the pottery made and/or imported for usage at this site. The entire assemblage is used for interpretations of human behavior patterns on this specific site.

Vessel Assemblage

An overall bowl to jar ratio can be calculated based on the analyzed sherds from 42Ka3976 to be 1:2.6. This ratio is distorted by the sampling procedure. All of the red wares and painted sherds with high percentages of bowl sherds were analyzed while less than half of the plain and corrugated sherds with high percentages of jar sherds were analyzed. Based on the vessel form ratios for the analyzed sherds, if all of the plain/corrugated sherds had also been analyzed, the bowl to jar ratio would be closer to 1:5.3. The variety of rim eversions found on jar sherds suggests different vessel forms with different functions. The vessel assemblage from 42Ka3976 includes painted and plain bowls and jars (of different forms) and miniature vessels. This indicates that a variety of living activities were taking place including storage, cooking, serving, and, perhaps, ceremonial activities. Although the majority of these vessels appear to be locally made, or at a common location, a mixture of vessels from outside the area are included in the assemblage primarily as red ware and painted vessels. These vessels may have served a special purpose.

Pottery Manufacture

By far the largest number of sherds from 42Ka3976 were made from very similar materials. The high percentages of tempers containing white coated quartz are comparable between the plain/corrugated sherds and the painted sherds. Although the clay sources seem to vary as indicated by the re-firing test, the clay shadings and observed textures between these two kinds of pottery are also comparable. Besides being painted, the primary difference between the local painted and plain/corrugated is the application of a slip before painting. Since the plain/corrugated sherds are not slipped, the slip was applied on sherds that were intended to be painted during manufacture. The local red ware sherds contain crushed sherds from local plain/corrugated and possibly painted sherds along with quartz similar to that used in the other local sherds. The clay in the two local red ware sherds that were re-fired fall within the Munsell colorings of the other kinds of local sherds. The gray sherd that re-fired to a polychrome sherd has both the original and re-fired Munsell colors as some corrugated sherds. The clay used for the local red wares may be the same as for the plain/corrugated and painted sherds but fired under different conditions to produce the red colors. Further testing, perhaps more controlled re-firings, could further test this idea. Based on these observations, the same materials were used to make the local plain/corrugated and painted pottery from 42Ka3976. The red wares were also made using similar materials with variations in temper composition and firing techniques. These similarities in materials used for pottery throughout the assemblage suggest that a source zone with slight variations between specific clay and non-plastic sources was available within the vicinity of the site.

Intrusive Pottery

The high percentage of pot sherds (93.9%) from 42Ka3976 with similar material composition are considered to be from locally made pottery while the rest of the pottery (6.9%) made with different materials are considered to have been made elsewhere. These percentages are based on the analyzed sherds but are expected to be much the same had all of the plain/corrugated pottery been analyzed. While some of this intrusive pottery is known to come from specific areas, the source of other sherds is ambiguous. Quartz temper sources are very widespread with differences occurring even

locally. Clay sources can also vary within a small area. The pottery considered to be either Virgin or Kayenta Anasazi pottery contains materials commonly used for this pottery throughout both regions making a specific source of manufacture difficult to ascertain. Some of the intrusive painted pottery has been identified as coming from the Kayenta Anasazi region while some of it has been identified as coming from the Virgin Anasazi region. The Moapa Gray Ware and Shivwits pottery come from the vicinity of Mt. Trumball and the Shivwits Plateau in the Virgin Anasazi region. The Tsegi Orange Ware pottery comes from northeastern Arizona in the Kayenta Anasazi region. Some of the black-on-white pottery is identified as Kayenta made while some of the black-on-gray pottery is defined as Virgin made. The intrusive pottery found at 42Ka3976 comes from both the Virgin Anasazi and the Kayenta Anasazi regions with no pottery coming from other sources.

The percentages of intrusive pottery making up each kind of pottery analyzed increase from plain/corrugated (2.8%) to painted (13.9%) to red wares (24.5%). Plain/corrugated pottery is generally thought to be locally made, an assumption supported at this site. The trace amounts of olivine tempered and sherd plus olivine tempered pottery at 42Ka3976 is consistent with findings from other sites in this area (Lyneis 1988). Sites in this area dating to late PII/early PIII include 5-10% red ware (Huffman et al. 1990: Figs 5.1, 5.2). The 3.8% red wares at 42Ka3976 are slightly lower than this figure. An interesting point about the red wares from 42Ka3976 is that three-fourths of it is locally made rather than being intrusive.

Pottery Distribution

The contexts in which the pottery was found at 42Ka3976 can be separated into two basic groups: the fill with disturbed contexts and floor contact with in situ contexts. The pottery types become important here with regard to dating and intrusive/local information. The pottery throughout the fill in each excavated group is thoroughly mixed with no obvious differences between painted design styles; plain/corrugated percentages; or red ware counts. Local and non-local pottery is also pretty well mixed throughout the fill. Pottery found in floor/bench contacts was more closely analyzed as far as distribution since such context provides more reliable information on those specific features. Table 6.7 lists the types of sherds found in contact with and/or near floors of structures. All of the structures have both plain and corrugated local pottery on the floors with Storage Room 1 having non-local plain and corrugated sherds on the floor and Pit Structure 1 having two Shivwits sherds. Pit Structure 4 had eleven whole/reconstructed vessels found from throughout the fill (not included in the table) including seven local painted vessels, two local corrugated vessels, one local red ware bowl and one non-local black-on-white corrugated bowl.

The painted sherds in both Pit Structure 1 and Pit Structure 4 are a combination of Sosi and Dogoszhi design styles and line elements. Lacking are Black Mesa style sherds which tend to date earlier than Sosi and Dogoszhi although some of the sherds with lines (from Pit Structure 1) could be from Black Mesa style vessels. Four non-local painted sherds (two Moapa Gray Ware black-on-gray and two Virgin Series North Creek Black-on-gray) were also found in Pit Structure 1. One non-local Kayenta Series black-on-white corrugated bowl was found in the fill of Pit Structure 4 (Fig. 6.1C). Also present were local red ware sherds. Based on this pottery, the dating of Pit Structure 1 and Pit Structure 4 lies within the late PII to early PIII time period.

Residential Room 1 had fewer sherds in floor contact with one Sosi style local painted sherd and one each of local and non-local red ware. Storage Room 1 had two Sosi style local painted sherds and no red wares. Pit Structure 3 had two painted local sherds and one local red ware. These three features probably also date to late PII to early PIII. Pit Structure 2 had only plain and corrugated local potsherds. Based only on this pottery, this feature dates to post-A.D.1050.

The pottery found at or near the floors of these features basically reflects the pottery found throughout the excavations with the exception of a lack of Black Mesa design style and Kayenta Series painted pottery. The sherds with a Black Mesa design style and Kayenta Series painted pottery were found distributed throughout different levels of fill. Otherwise, local and non-local potsherds are found both in floor contact and in the fill. Unfortunately, the distribution of the pottery found during these excavations at 42Ka3976 does not present information to help narrow the dates of these structures.

Depth	Local Plain	Local Corrugated	Virgin/Kayenta Plain	Virgin/Kayenta Corrugated	Shivwits	Local Painted	Sosi	Dogoszhi	Fine Line	Narrow Line	Medium Line	Wide Line	Narrow-Medium Line	Narrow-Wide Line	Straight hatching	No Paint	Moapa Gray Ware (B/G)	Virgin Series Painted	Sosi	Wide Line	Local Red Ware	Local Polychrome	Tsegi Orange	Tsegi Polychrome	Total
Residential Room 1																									
Upper Floor Contact	4	23					1									1							1		**30**
Fill Between Floors	1	1																			1				**3**
Lower Floor Contact	2	2																							**4**
Storage Room 1																									
Floor Contact	1	4	1																						**6**
Lower Floor Contact	1	2		1			2																		**6**
Pit Structure 1																									
Floor Contact	5	69			2		2	9				2	1	1	4	1	2		2		9	1			**110**
Pithouse Floor	3	4									1				4										**12**
Pit Structure 3																									
5-10cm Above Floor	1	17														2									**20**
Floor Contact	3																				1				**4**
Pit Structure 4																									
Floor Contact	1	7																							**8**
Pit Structure 2																									
Floor Contact	1																								**1**
Floor Contact Lower 5cm	15	17																							**32**

Table 6.7. Distibution of potsherds by type found in contact with floors and bench at 42Ka3976.

Discussion

Shinarump Problem

According to Walling and Thompson, Euler's revision of the definition of Shinarump Plain is "more closely in tune with current thinking" than Colton's (1988:51). Euler's description includes dark paste, with primarily a quartz temper of translucent, occasionally opaque rounded to subangular grains sometimes with an opaque white coating (in Walling and Thompson 1988:51). Lyneis describes the dark gray to red colors as "probably the key characteristic of the Shinarump types" with temper being more variable (1998:21). Dark clay colors seem to be the characteristic used for identifying Shinarump types of pottery. The area of production for Shinarump pottery seems to be in the vicinity of Johnson Canyon (Walling and Thompson 1988:51), although Lyneis emphasizes the need for "good quantified ceramics frequency data based on a consistent definition" to clarify this (Lyneis 1998:22). After reviewing ceramic classifications and the use of Shinarump types at sites throughout the region, the need for a consistent definition is evident. The variability in Shinarump usage does not allow for valid comparisons between sites and certainly invalidates its frequency data.

Some of the local plain and corrugated pottery from 42Ka3976 closely fit these descriptions of Shinarump. The problem with calling this portion of the local pottery Shinarump is that this pottery cannot be satisfactorily separated from the larger group that has common material characteristics. The local pottery from 42Ka3976 is grouped by having a range of common temper components and clay colorings. Clay colorings are the most variable which was confirmed through re-firing testing. Although the majority of the dark clay colored sherds could be called Shinarump, the medium and light colored clays also contain some "Shinarump" sherds that cannot be separated from the others. At 42Ka3976, the overall material composition distinguishes the local pottery from other Virgin/Kayenta Anasazi made pottery. This presents a problem for comparing the pottery types from 42Ka3976 to pottery types found at other sites due to the variable definitions of Shinarump. Two studies, Lyneis' The Shinarump Problem 2 (1998) and Wilson's Vermilion Cliffs ceramic analysis (1985), that focus on descriptions of materials used allow for comparisons with the pottery from 42Ka3976.

Lyneis' (1998) Shinarump project uses re-firing and petrographic analyses on sherd samples from various sites from around the area east of Kanab. Temper varies within the sample with quartz, of variable angularities and degrees of sorting, being the dominant component (Lyneis 1998:6-11). The temper types found in the local pottery from 42Ka3976 fall within some of Lyneis' temper descriptions, especially the subrounded to subangular quartz group. Lyneis also found sherd temper in a variety of colors as a minor component to quartz with two red ware sherds showing more sherd than quartz (1998:9). This is also consistent with the local sherds from 42Ka3976 in which sherd temper appears in plain/corrugated and painted pottery in minor amounts and in red wares as the dominant component. The re-firing results of Lyneis' sample display quite a variety in clay colors (1998:12, Tables 2, 3). The re-fired colors of Virgin Black-on-white sherds and Shinarump-type reds fall within the color ranges of re-fired plain and corrugated sherds. Again, the re-firing results of 42Ka3976 are comparable. According to Lyneis, vitrification "is apparently an expression of the amount of iron in the clay" (1998:12). More of the darker sherds in Table 6.3 seem to be vitrified than the lighter sherds. The iron content seems to have an effect on the darker coloring of sherds and vitrification.

In Wilson's analysis of ceramics from the Vermilion Cliffs Project, two major temper types of sand or crushed sandstone that "could easily have been derived form the same or similar sources" were found (1985:116). The first temper type consists of sand grains with the second temper type consisting of sand grains plus sand grains held together with a white matrix and/or individual white matrix fragments. Wilson also notes the presence of sherd temper in a small number of sherds. These temper descriptions are similar to the white quartz and quartz plus white quartz temper types along with noted sherd temper presence found at 42Ka3976. Wilson also observed a wide range in paste color from which he selected a sample for re-firing (1985:116-117). His re-firing results are much the same as those for 42Ka3976 with the very dark sherds firing to consistent colors and the lighter sherds firing to a wider range of colors. Wilson does not mention finding sherds that are half dark and

half light like some of those found at 42Ka3976. He also does not mention whether or not lighter paste was found in Shinarump White Wares although he concludes that similar materials were used for these as for plain and corrugated pottery. The red wares from the Vermilion Cliffs Project have paste and temper characteristics similar to oxidized Shinarump ceramics (Wilson 1985:119). This use of the same materials for plain/corrugated pottery as for painted and red ware pottery is also found at 42Ka3976. The red ware sherds from the Vermilion Cliffs Project are described as having crushed sandstone temper with no mention of sherd temper like that found at 42Ka3976. This difference could be regional or even perhaps chronological with the Vermilion Cliffs sites dating earlier (Basketmaker III through Pueblo II) than 42Ka3976 (late Pueblo II/early Pueblo III). More incidences of vitrification were observed in the darker sherds than the lighter sherds from the Vermilion Cliffs Project (Wilson 1985:117). This was not intentionally observed at 42Ka3976 although vitrification was noticed in all clay color ranges.

These three studies discuss similarities that can be found in the pottery used for each one with variability still evident. This variability raises questions about the identification of Shinarump pottery with important implications when it is found away from the area of production and more likely to be mixed with other types. Most likely, the light clay colored and some of the medium colored sherds from 42Ka3976 would not be considered to be Shinarump if found at other sites in the Virgin Anasazi region. (This may be true in the Kayenta region although the presence of Shinarump here does not seem to have been examined or is non-existent.) The painted pottery is more easily recognized as different with the presence of a creamy colored slip on both surfaces. The red wares also can be distinguished by the quartz sand and/or variable sherd temper. At this point, defining the local pottery of 42Ka3976, particularly the plain/corrugated pottery, as Shinarump would add to the Shinarump confusion.

More testing, such as expanding Lyneis' re-firing and petrographic analyses to include less traditional Shinarump pottery, is very much needed. To help test production locales, sand and clay samples should be compared to the pottery itself. 42Ka3976 presents the opportunity to test this with its large number of sherds having common material characteristics. Thorough examinations of pottery at more sites in this area need to be done with material characteristics described for valid intersite comparisons. These kinds of studies can help determine the validity of Shinarump types themselves.

Cultural Affiliation

Wilson warns that "it is usually not possible to distinguish ceramics belonging to these series [Tusayan Gray or White Ware] on the basis of temper and paste alone, and their assignment is often based on the area of Anasazi thought to be represented, resulting in very circular spatial divisions" (1985:119). Wilson is undoubtedly referring to a common assumption made that type assignment connotes production locale. In the Vermilion Cliffs Project, Wilson (1985) avoids the use of more specific type designations than the ware level. Shinarump pottery at these sites is described as locally made. He then concludes that the Vermilion Cliffs Project ceramics "appear to represent Virgin Anasazi types" based on the material composition and the absence of identifiable Kayenta tradition ceramics.

The ceramics from 42Ka3976 contain sherds made locally as well as from both the Virgin and Kayenta Anasazi regions. Even assigning this pottery to types based on the "area of Anasazi thought to be represented" proves difficult because of the site's proximity to borders of both the Virgin and Kayenta regions. Based on the pottery alone, a cultural affiliation of the locally made pottery cannot be satisfactorily assigned. This information combined with other site information may provide a cultural affiliation.

Self-sufficiency

Pottery Knoll (42Ka1568) is located within miles of 42Ka3976 and dates to Pueblo III times. Neff, Larson and Glascock (1997) present evidence through neutron activation analysis on a sample of sherds that the Pottery Knoll ceramic assemblage contains a large amount of non-local (44% is suggested) ceramics that refutes a self-sufficiency model. They propose that a community self-sufficiency model "implies that all pottery was produced from locally-available resources" which would be reflected in a "low assemblage compositional

diversity" (Neff, et al., 1997:474). Based on their studies, a high compositional diversity was found in the sample indicating that various material sources were used to make the pottery. This diversity combined with weak patterning supports the idea "in which movement of vessels across the landscape is favored in the absence of local specialization" (Neff, et al., 1997:489). Weak material composition patterning within the sherd sample from Pottery Knoll demonstrates a lack of local specialization. Neff, Larson and Glascock then argue "that the agriculturally risky environment of the northern Southwest created conditions" that "led, by Pueblo III times, to the accumulation of compositionally diverse, weakly patterned ceramic assemblages like that from Pottery Knoll" (1997:489).

The late PII/early PIII ceramic assemblage of 42Ka3976, on the other hand, seems to support a self-sufficiency model. The extremely high percentage of locally made ceramics with a limited compositional diversity fit Neff, Larson and Glascock's proposed expectations for a self-sufficient community. Overall, the assemblage at 42Ka3976 also demonstrates weak patterning between material composition and ware groups with specific materials being used in only small specific groups. This suggests some degree of local specialization in both the Virgin and Kayenta Anasazi regions with the olivine tempered Moapa Gray Ware coming from a specific location and the Tsegi Orange Wares coming from another specific location. At this site it appears that making the entire assemblage in a local area is favored over the movement of pottery from other areas. This also indicates that the environmental conditions of the northern Southwest during this time period did not always lead to a compositionally diverse assemblage and that, at least in some locations, self-sufficiency was still favored.

Obviously more research is needed in this area during this time period to gain an overview of site usages and behavioral patterns. To expand on both the ceramic research at 42Ka3976 and Pottery Knoll, geological studies need to be conducted and combined with the ceramic studies. It is already known that both temper and clay sources are available within immediate site vicinities (Doelling, et al. 1989) but they have not been tested to see if those sources are comparable to the material compositions of the pottery. Lyneis' Shinarump study includes some petrographic samples from the Shinarump Conglomerate, Navajo Sandstone and Deer Spring Wash sand with her sherd samples noting comparable compositions in some cases (1998:7-9). This kind of study conducted specifically for these sites and the possible sources in the immediate vicinity may answer some of the local/non-local pottery manufacture questions. Clays also need to be examined. McFadden (p.c.) observed a variety of clay colors in an arroyo cut near 42Ka3976 that deserves comparative testing with the site's pottery. Re-firing tests on the clay samples could easily be added to the re-fired pottery sample from 42Ka3976. Expanding ceramic analysis to include these kinds of tests would greatly help in the interpretation of where the pottery may have come from which could be expanded to testing such models as self-sufficiency.

Summary

When first beginning a study of a large number of potsherds from one site, the thought of being able to divide them into identifiable groups then giving them type names sits in the back of the mind. The pottery from 42Ka3976 never brought this thought out to completion. In fact, the pottery from 42Ka3976 may even raise more questions than provide answers about pottery types. The data collected from this site is presented in more of a descriptive manner in hopes of allowing for better comparisons between sites. It seems that this approach better serves the current stage of research, particularly when addressing the Shinarump problem. Population movement is a major research question of particular interest during late PII/early PIII times with pottery studies having the potential to help with answers. The extremely high percentages of local pottery combined with smaller amounts of intrusive pottery from western and eastern sources that make up the late PII/early PIII assemblage at 42Ka3976 has interesting implications for population movement and contact. While some form of contact with peoples of both the Virgin and Kayenta Anasazi regions is evident, the high proportion of locally made pottery suggests a self-sufficient community at this late PII/early PIII site.

INTACT AND RESTORABLE VESSELS

by
David Van Alfen

Among the ceramic material collected from 42Ka3976 are a total of eleven intact or restorable vessels. The eight bowls and three jars conform with descriptions of the local Late Pueblo II types: North Creek Black-on-gray (3), Hildale Black-on-gray (3), Pipe Spring Black-on-gray (1), Middleton Red (1), and North Creek Corrugated (2)[1]. Two vessels remain typologically indeterminate: a small painted jar and a painted, white-slipped redware[2].

Detailed observations were recorded for all vessels because of a belief that details of ceramic materials and construction may show patterning in this geologically diverse region of the prehistoric world. Observations of materials, construction technique, form and surface treatment were made. In addition, any indications of the firing regimen or evidence for the use and repair of the vessels were recorded. Due to a scarcity of information from the local area, the analysis must remain primarily descriptive.

Gross vessel dimensions were recorded using a metric tape measure and all smaller metric measurements using a dial caliper. In all cases, measurements were rounded to the nearest quarter millimeter. Observations on inclusions in the ceramic matrix were made using a dual power binocular microscope at 15X and 45X magnification. Observations were obtained from wall cross-sections when available, or by an extensive scanning of the surface on unbroken vessels. Vessel volumes were determined by lining the interior of the vessel with paper and filling the vessel flush to its rim with bird seed that was then measured using a graduated cylinder.

Inclusions

Inclusions are generally defined as all materials present in a clay or ceramic body. The term is used to avoid implying that all the materials present in a clay paste were deliberately added by the potter (Rice 1987). The justification for detailed investigations of inclusions is the identification of patterns that can reflect the scale of ceramic production and exchange and/or indicate technological decisions made by the potters (Shepard 1956, Rice 1987).

At the most detailed view, the eleven vessels from the Arroyo site could represent as many as nine or more unique mixes of clay and inclusions. With a slightly broader view, however, there are only two inclusion groups (quartz sand and/or sandstone, and quartz sand plus opaque fragments) and three to four very general paste groups.

All vessels contain some form of quartz sand. The quartz sand was generally an angular to well rounded, translucent, medium to fine-grained sand that could derive from a number of natural depositional environments and/or behavioral practices. In the majority of vessels, the quartz sand is well rounded and of a uniform size less than .25 mm. The roundedness and uniform, small size of this quartz indicates individually transported grains deposited in an environment that allowed for grading of the deposits. Some of the quartz could derive from sandstones because of what appears to be a white and red carbonate coating on the grains. Quartz is the only inclusion in two of the vessels (Fig. 6.1E, F), though both remain unbroken and could contain other material. In all vessels but one (Fig. 6.1B) quartz sand predominates. Within FS 163, a chalky, white material is seen to predominate.

In addition to quartz, the majority of vessels also contained various opaque fragments. Opaque fragments ranged from very angular to rounded, medium to very coarse grains of materials such as clay, sherd, rock, and possible carbonates, feldspars, and basalt. The angularity of many of the opaque fragments indicates they may have been crushed and deliberately added to the paste, or entered the paste through clay processing techniques (crushing, grinding, etc.).

The small size of most of the opaque fragments (generally .25 mm and less) indicates that if potters deliberately crushed these materials for temper, they did a very thorough job. Since the majority of quartz aplastics overlap in this size range, this may indicate the potters were selecting for particles of this small size. However, the presence of very similar quartz was found in daub fragments from the site, which may indicate that this quartz was available directly

1 Based upon comparison with published descriptions and images (Colton 1952; Lister 1959, 1960, 1961; Lyneis 1992; Schroeder 1955; Thompson 1971, 1986, 1988; Wade 1967).

2 Editors note: Figure captions for several vessels have been changed to reflect current interpretations for ware and type designations.

underfoot, or may even be a natural inclusion.

Ceramic Matrix

The ceramic portion of the paste is generally thought to be more helpful than inclusions in sourcing vessels in a sand-rich environment (Wilson 1985). However, without some form of destructive analysis, little can be said of the range of clay materials. Because of this limitation, I made very general observations of the texture, presence of voids, and color of the ceramic matrix. Though problematic, there are four to five broad groups of building and slip clays represented in the vessels. These groups are merely analytic groups and are not believed to represent actual clay sources.

The largest group of building clays fire white (2.5Y-10YR 8/1) in a neutral to oxidizing atmosphere. Only a single vessel of the seven in this group exhibit a dark core (though 3 remained unbroken).

The next clay group are iron rich clays that fire red (10R 5/6; 2.5YR 4/6) in an oxidizing atmosphere. The two vessels in this group (Fig. 6.1A, G) derive from two different pastes sharing only a red surface color. One of these vessels (FS 199) is truly unique in that the interior and exterior surfaces were covered with a white slip before being painted, giving the vessel the appearance of a black-on-white vessel but on a red base.

The final two vessels could belong to a single clay group, two different clay groups, or either one of the groups previously mentioned. The canteen (Fig. 6.2A) fired pale brown (10YR 6/3) in a poorly controlled oxidizing atmosphere, while the handled jar (Fig. 6.2B) fired dark gray (5YR 5/1) in a probable neutral to reducing atmosphere.

Only two of the eleven vessels exhibit a darker core than the vessel surfaces perhaps indicating a uniformity in firing regimen for most of the vessels (however, four vessels were unbroken and could not be observed). Paste textures range from very fine-grained with few voids (4 vessels) to granular with abundant linear voids (3 vessels). No correlations between inclusions and clays were found.

Four of the bowls have a white slip (2.5Y-5Y 8/1) present on the interior. Only one of these bowls (Fig. 6.1A) also has the exterior slipped. The slips are relatively thick and only appear crazed in areas where they may have pooled-up. All vessels could have the same slip, though the slip on the redware may be different. The slips would have required different clay groups from those previously mentioned.

Form

Eight bowls (Fig. 6.1) and three jars (Fig. 6.2) were recovered from the Arroyo site. The bowl and jar forms conform to published descriptions and images of local Pueblo II vessels (Walling et al. 1986, Wade 1967), though the miniature canteen may be considered a rare form.

All bowls exhibit a complete hemispherical shape, except for figure 6.1A, which has a more conical base. The height and width of individual bowls are very similar and indicates a high symmetry of form. The bowls sorted evenly into two size groups based on volume: large and small. The small bowls have volumes near 1.0 liter, and range in size from 7 to 8 cm in height and diameter. The large bowls are three times larger (about 3.0 liters), ranging in size from 10 to 12 cm in height and diameter. There are, of course, two exceptions: bowl A falls short of the small group at .5 liters, while bowl E is intermediary between the small and large bowls at 2.0 liters.

Based upon observations of a small comparative sample of Late Pueblo II bowls, I believe these size classes may represent a reality. The bowls vary in size between sites, but within sites bowls seem to come in two sizes, with the larger generally twice as large.

The jars are very similar in form, appearing in profile as a slightly squashed oval. All jars have a discernible neck and lack a distinct shoulder. All jars differ, however, in orifice diameter and size. Two of the jar forms (Fig. 6.2B, C) have an unrestricted orifice and can be considered open forms. Open forms are believed to be used for cooking, dry storage, food preparation, and any activity in which you need access to the pot's interior (Braun 1983, Rice 1987). Both of these open jars can also be considered different degrees of small: the larger with a volume of 1.4 liters, the smaller jar holding .3 liters. The larger of these vessels has two coils of clay affixed 23 mm apart just below the exterior rim. The coils curve towards, but do not connect with, each other and the vessel surface. These handles may have functioned to facilitate suspension when empty or may have been decorative (Beals, Brainerd, and Smith 1945).

The remaining jar (Fig. 6.2A) has a small capacity (.3 liters) and a highly restricted orifice that is usually associated with wet storage or transport (Rice 1987). The vessel also has two perforated lug handles that appear to have been added during the coiling process. The lugs are set on opposite sides of the vessel midway between the neck and shoulder inflection points. This small, restricted jar may have functioned to transport or store precious liquids or may have served a purpose not related to its form.

Corrugation

Two jars and one bowl (Fig. 6.1C) exhibit a corrugated exterior surface. Two of these vessels (the large jar and bowl) display deep, regular finger indentations that give the appearance of a downward, right spiral on the vessel surface. Both vessels have 7-8 coils and 25 plus indentations per 4 cm^2. The miniature canteen is banded, lacking indentations of any kind. The canteen averages 11-12 coils per $4cm^2$.

Painted Decoration

Anna Shepard (1956) was the first researcher to champion the use of crystallographic symmetry to describe and analyze painted designs on ceramics. While the painted ceramics from the Arroyo site are described in terms of symmetry, it should be understood that none of the designs are truly symmetrical. In all cases the symmetry of the overall design is destroyed by a change in usually a single motif translation (Fig. 6.3).

Seven of the eight bowls and one of the jars from the Arroyo site exhibit painted decoration. The field and focus of decoration on the bowls is restricted to the inside of the vessel walls. The decoration of the jar appears on the exterior vessel wall between the shoulder and the rim.

All eight designs are banded designs. Six of the eight designs are translated one-dimensional banded decorations with at least one framing line above and below. The two exceptions are the decorated jar (Fig. 6.2C), which, though framed, has no symmetry to the design; and the painted/corrugated bowl (Fig. 6.1C) which has only a single framing line at the top. FS 199 could also be considered unusual for the local region due to the number of framing lines above (2) and below (3) the band, a pattern that appears to be uncommon to the area (Fig. 6.3).

Design elements differ between the jar and bowl designs. Broad lines (5 mm average width), elongated solid triangles, and fine lines (2 mm average width) are the most common elements on the bowls. Elements found on the jar consist of broad lines, dots, and solid rectangles and squares. All elements, except dots, are common on Late Pueblo II vessels. Dots generally vanish from designs before A.D. 1050.

The most common element of the designs is the strikingly elongated triangle. Thompson (1988) first noted the elongated isosceles and acute triangle element appearing on vessels between A.D. 900-1050. Examples of this element with and without pendant dots can be found in published illustrations from both pre- and post-corrugated Pueblo II sites (Dalley and McFadden 1985; Walling et al. 1986; Walling and Thompson 1988).

Bowl motifs consist of two general categories: broad line and fine line. The broad line motifs generally take the form of an acute triangle composed of broad lines and elongated solid triangles. The motif is then duplicated in a two-fold rotation that is translated around the bowl walls two, three or four times. Figure 6.1A is a simple example of this pattern with a single exaggerated triangle that is duplicated by a two-fold rotation and translated three times around the bowl interior.

The fine line motifs consist of diagonal fine lines in either running rectilinear panels or in isosceles triangles that are then translated six or nine times around the vessel interior. A variation is found with the motif on figure 6.1H in which parallel fine lines are cross-hatched within a diamond. Symmetry of the motifs consists of two-fold rotations (Fig. 6.1F, H) and glide planes (Fig 6.1C).

In terms of design elements, layout, and symmetry, the painted decorations of all but three of the vessels are consistent with the local manifestations of the Sosi style (broad line motifs) and the Dogoszhi style (fine-line motifs). The exceptions are the painted jar (Fig. 6.2C), the white-slipped redware bowl (Fig. 6.1A), and the bowl with the cross-hatched diamond motif (Fig. 6.3H), though the latter may represent a local variant of Dogoszhi style (Fig. 6.1H).

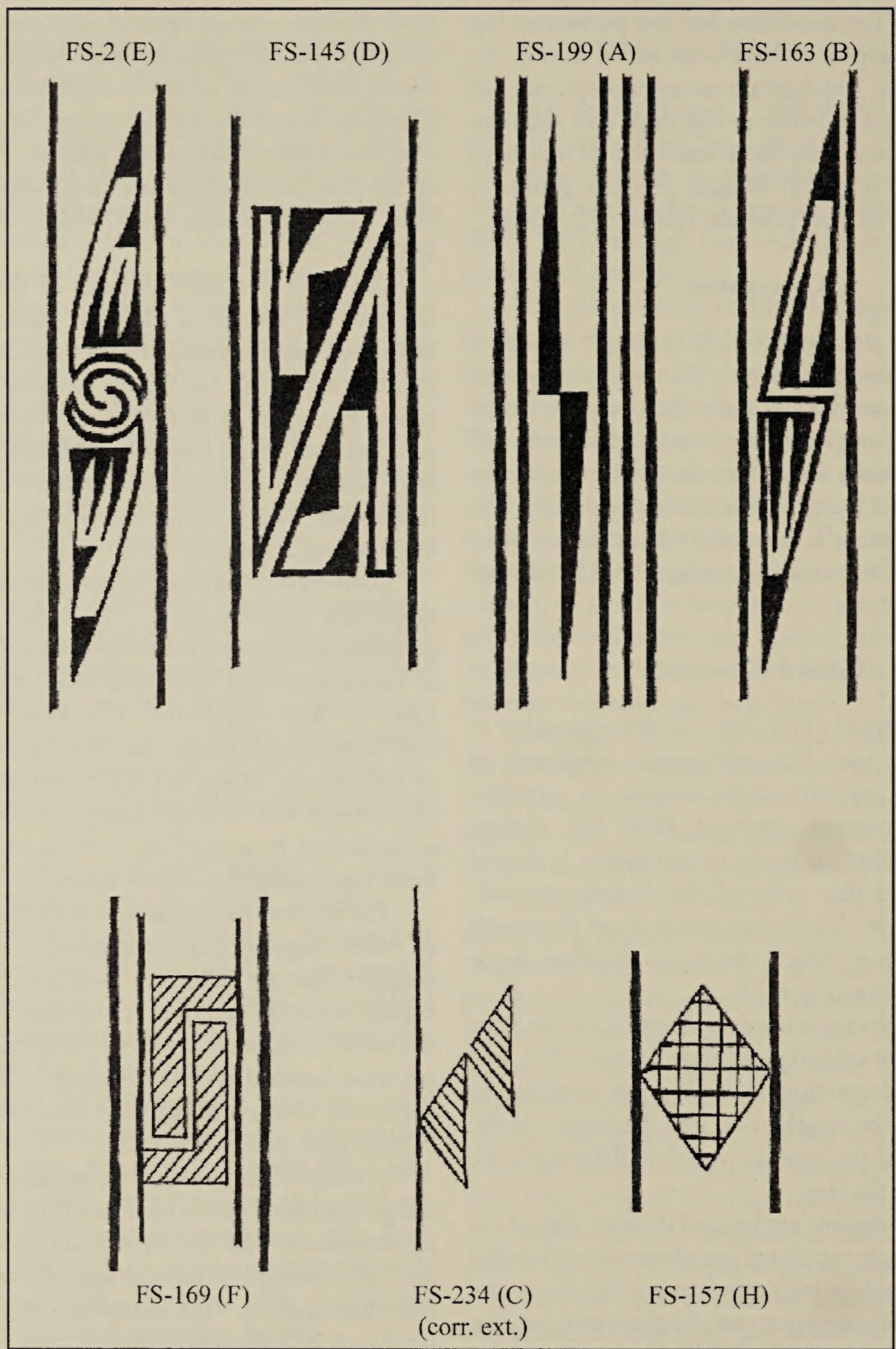


Figure 6.3. Translation elements of bowl designs from 42Ka3976 (letters refer to figure 6.1).

Use and Repair

Use wear on vessels is usually identified by patterned abrasion or damage of the surfaces, and by the presence of sooting or staining (Rice 1987). A total of seven vessels from the Arroyo site display some evidence for use. Five of the bowls and only a single jar (miniature canteen) exhibit a slight abrasion in a small area on and around the exterior base.

Two vessels (Fig. 6.1D, F) have stains located on the interior surface, while the larger jar (Fig. 6.2B) has a sooted exterior. The stains are large (12.0 cm diameter on FS 169), roughly circular, and reddish-yellow (5YR 6/8) in color. Both appear slightly off center of the interior base of large bowls. The stain appears to be from a liquid material and could represent the production of a red ochre wash.

A single bowl had post-firing holes drilled through the wall on opposite sides of the vessel. One hole, located 10 mm below the rim, was apparently biconically drilled with a minimum diameter of 6 mm. The other hole was located 8 mm below the rim and was drilled from the inside surface (5 mm minimum diameter). Another partial hole is found on the exterior surface offset from the interior-drilled hole.

Summary and Discussion

The materials, forms and designs of all but two of the Arroyo site vessels are consistent with published descriptions and images of Pueblo II Virgin Anasazi ceramics. The two exceptions are a small painted jar and a black-on-white redware bowl.

The painted jar is problematic in that the combination of design elements (namely dots in bounded areas) has been described as characteristic of both Basketmaker III designs (Thompson 1986) and Early Pueblo II designs (Lister 1961). The banded layout is also of little help, since banded layouts are known from Pueblo I (across the bowl) and Pueblo II contexts. Additionally, the jar form may restrict the type of layout.

The jar design differs from the bowl designs in its poorly controlled execution, complete lack of symmetry and unusual motifs. Nearly all published examples of St. George Black-on-gray, the early Pueblo II pottery type, have definite symmetry to the motifs and layout and generally display crisp, parallel line edges. Further, the presence of multiple dots arranged within a rectilinear element appears to be uncommon on St. George, though dots pendant from solid elements and lines are prevalent.

Thompson recovered a very similar jar in terms of size, form and polish, but with a dark brown color and no decoration, from the Little Jug Site (GC-663) dated between A.D. 100-300. In fact, the only details that trouble me with this vessel belonging to the Basketmaker III period are the polished, stark white surface and the broad lines, both uncharacteristic of Basketmaker pottery described by Colton (1952).

The white-slipped redware vessel is an oddity. The vessel is intact and was determined to be a redware from the interior and exterior base where the slip has worn off. The paste of the vessel was red (10R5/6) and contained medium to fine quartz sand and angular black fragments. The slip was white (5Y8/1-10YR8/1) and heavily crazed along the interior walls. The exterior slip was generally dull with high spots exhibiting a polish and wasn't crazed. The design, as previously mentioned, is unusual for the area because of the high number of framing lines. The vessel probably represents a very unusual Deadman's Black-on-red.

MISCELLANEOUS CERAMIC ARTIFACTS

by
David Van Alfen

Miscellaneous ceramic artifact is a category within ceramic studies that generally includes a diverse group of artifacts that are made of clay, but do not fit into the sherd category. This category of objects has only recently begun to receive attention in archaeology (Di Peso 1974, Herr 1993, Oppelt 1984, Waterworth and Blinman 1986).

To investigate and describe the range of variation in these objects, I split the ceramic artifacts into two general categories: modeled objects and recycled objects. Modeled objects are ceramic artifacts that appear to have been deliberately created from raw materials. Modeled objects from the Arroyo site include handles, silty/temperless clay objects, and daub. Recycled objects are artifacts that have found new life from the remnants of another object, typically a broken vessel. Recycled objects

include ceramic disks, scrapers and/or scoops, platter fragments, and edge-modified sherds.

Handles

Ceramic handles include all clay objects that appear to ease manipulation of an object with the hand or to distance the hand from the object. In addition, there are handles that facilitate suspension, and objects often classed as handles that could not function in any load-bearing way, and may be purely decorative (Beals, Brainerd, and Smith 1945). Further, a number of thick, fired coil objects or fragments invariably end up in this category that may or may not be handle fragments.

The ceramic collection from 42Ka3976 contained a total of 23 handles and handle fragments. The majority of handles came from only three proveniences: Pit Structure 1 (10), Pit Structure 2 (6), and Pit Structure 3 (3). I initially sorted these 23 handles into coil, strap, lug and indeterminate groups. I then recorded the range of stylistic or formal variation within each of these groups. Though a large number of handles remain indeterminate, two assumed functional types of handles are represented: grasping handles (11) and suspension handles (2). Orifice diameters of grasping handles were measured directly when possible or estimated using a 360° disk calculator (based on rim calculator). The grasping handles all had orifice diameters between 2-4 cm. A single perforated lug handle was recovered. It derives from the wall of a plain jar and has an orifice diameter of 4.5 mm.

Coil objects and handles predominate in the collection (16) and were sorted as follows: Half coil (1), Single coil (6), Ridged Coil (1), Single Attachment Coil (1), Two-Parallel Coils (2), Three-Parallel Coils (2), and Twined Coils (3). Most groups are self-descriptive, though a few need further clarification. The ridged coil handle has three parallel ridges (formed by pinching the clay) that curve along the exterior of the handle. The twined coils all consisted of four coils affixed in a circular pattern and then twisted in a clockwise direction. The single attachment coil is a tapering, curved coil that is affixed below the rim, and then curves down and towards the surface without contacting it. A similar handle is found on an intact jar from the Arroyo site (FS 200), and from sites in Tsegi Canyon in Northeastern Arizona (Beals, Brainerd, and Smith 1945).

Fragments of four strap handles were recovered; one of which is a fragment of a St. George Black-on-gray ladle. The ladle handle is a strap with the edges curved upwards forming a shallow trough. The handle is 7 mm thick and 25-30 mm wide, tapering away from the bowl. Only a small segment of the ladle bowl, displaying small, skewed, solid triangles pendant from the rim, exists at the termination of the handle. The remaining strap handles all have curvature indicative of grasping handles, and ranged from 6-10 mm thick and 21-25 mm wide.

An interesting form of handle construction was identified on two coil handles. These handles appear to have been affixed by passing the coil through a hole drilled in the vessel wall. The coil was then smoothed with the interior and exterior surfaces to further strengthen this "plug." Watson Smith on ladle handles from Tsegi Canyon (1945) identified a similar construction technique. This type of handle construction would seem to be much more load-bearing than most appliquéd handles. However, the similar breakage on these specimens and others identified from excavations near Colorado City (42Ws3119) indicates that these handle plugs may "pop-out" at inopportune moments, causing vessel failure.

Silty/Temperless Objects

Objects in this class are very similar to those described by Lister from the Coombs Site (1959). A total of 25 silty/temperless objects were recovered from multiple contexts on the Arroyo site. However, just over half of the objects derive from only two contexts: Pit Structure 1 and Pit Structure 2. The majority of objects in this class (14) are fragments of miniature vessels. The miniature vessels appear to have been formed by pinching rather than coiling, and all appear to be either unfired, or low-fired.

Two additional objects may be fragments of miniature effigy vessels: one, a closed conical fragment reminiscent of the pointed terminus of a duck effigy vessel; and two, a clay tube with a partial rim/prepared surface and a clay appendage. The appendage is a 12 mm long clay coil fixed at 90° to the wall of the tube. The coil displays a fattened, triconical terminus that exhibits breaks on two of

the prominences. The object is similar to heads of animal effigy fragments from Colorado City and Little Creek Mesa.

The remaining objects are nondescript clay coil fragments (7) and unidentifiable, amorphous objects (2). The majority of coils were about 5mm in diameter. Both coil termini and segments were present.

Daub

Five fragments of stick-impressed daub were recovered from two proveniences at the Arroyo site: the fill of Residential Room 1, and the bench fill of Pit Structure 3. All fragments contained 40% or greater, fine grained, well-rounded quartz sand with stick impressions generally less than 0.5cm wide. The daub is indicative of jacal construction, where the sand and clay mixture is applied to a layer of small sticks that are either woven between larger sticks for walls, or laid upon larger sticks for roof construction.

Ceramic Disks

Circular objects chipped and ground from sherds are commonly encountered in the archaeological record (Figs. 6.4, 6.5) Researchers have postulated various uses for these objects that include gaming pieces, pot lids, adornment, and spindle whorls for the perforated disks (Oppelt 1984). Included in the Arroyo site collection are a total of 34 disks and 12 possible disk fragments from numerous proveniences. To investigate the possibility of size classes among these disks, I recorded the diameter, weight, surface treatment, presence of perforation, and diameter of perforation. I then arrayed the disks on a bivariate plot of weight and diameter for both the perforated and unperforated disks. Though the majority of disks were between 2 cm and 4 cm diameter and weighed between 2 g and 10 g, no meaningful patterns were identified within the unperforated or perforated arrays.

Of the 46 disks and fragments recovered, the majority were of black-on-gray sherds (17), with the rest sorting almost evenly into plain (8), corrugated (7), black-on-red (7), plain red (6), and a single painted and corrugated sherd. Though the majority of black-on-gray designs were too small to be identified, two were identified as St. George Black-on-gray, twelve exhibited broad lines or solid objects, and three displayed narrow lines. The black-on-red designs appeared to be almost exclusively Deadman's style (5), though a few could be Dogoszhi.

Scrapers and/or Scoops

Sherds were also used historically and prehistorically as scrapers for ceramic production (kajepes), as general scrapers, and as scoops (Oppelt 1984, Herr 1993, Waterworth and Blinman 1986). The objects in this category were grouped by the presence of ground, beveled edges. The beveled edges are indicative of an angled pulling or pushing motion (Fig. 6.6).

Five objects that could be scrapers and/or scoop fragments were recovered from the Arroyo site. Four of the objects are made from slipped, sand-tempered redware sherds and come from a single context (Pit Structure 2 floor contact) while the fifth is from a heavily damaged Virgin series black-on-gray (Pit Structure 1 floor contact). Three of the redware objects, all complete or nearly so, display evidence that they acted as scrapers. The edges of these objects exhibit slight grooves and drumlins[3] on the interior beveled face that indicate they were pulled across a surface at roughly a 60-70° angle. This unidirectional pulling motion (pressing motion in Waterworth and Blinman 1986) is characteristic of *kajepes*, or pottery scrapers. All three of these redware scrapers were found on the floor contact of Pit Structure 2.

Puki/Platter

Pukis are platters or bowls that were used historically and prehistorically to aid in the construction of vessels (Herr 1993). Four sherds from the floor contact of Storage Room 1 appear to be edge fragments from a single platter (Fig. 6.7). The interior surface of these sherds exhibit occasional flake scars and light grinding along an occasionally ground, curved edge. The sherds appear to be from near the base of a slightly obliterated corrugated vessel.

3 Drumlin is a term borrowed from geology to indicate a raised clay "shadow" behind prominent aplastics that is indicative of unidirectional abrasion (Waterworth and Blinman 1986).

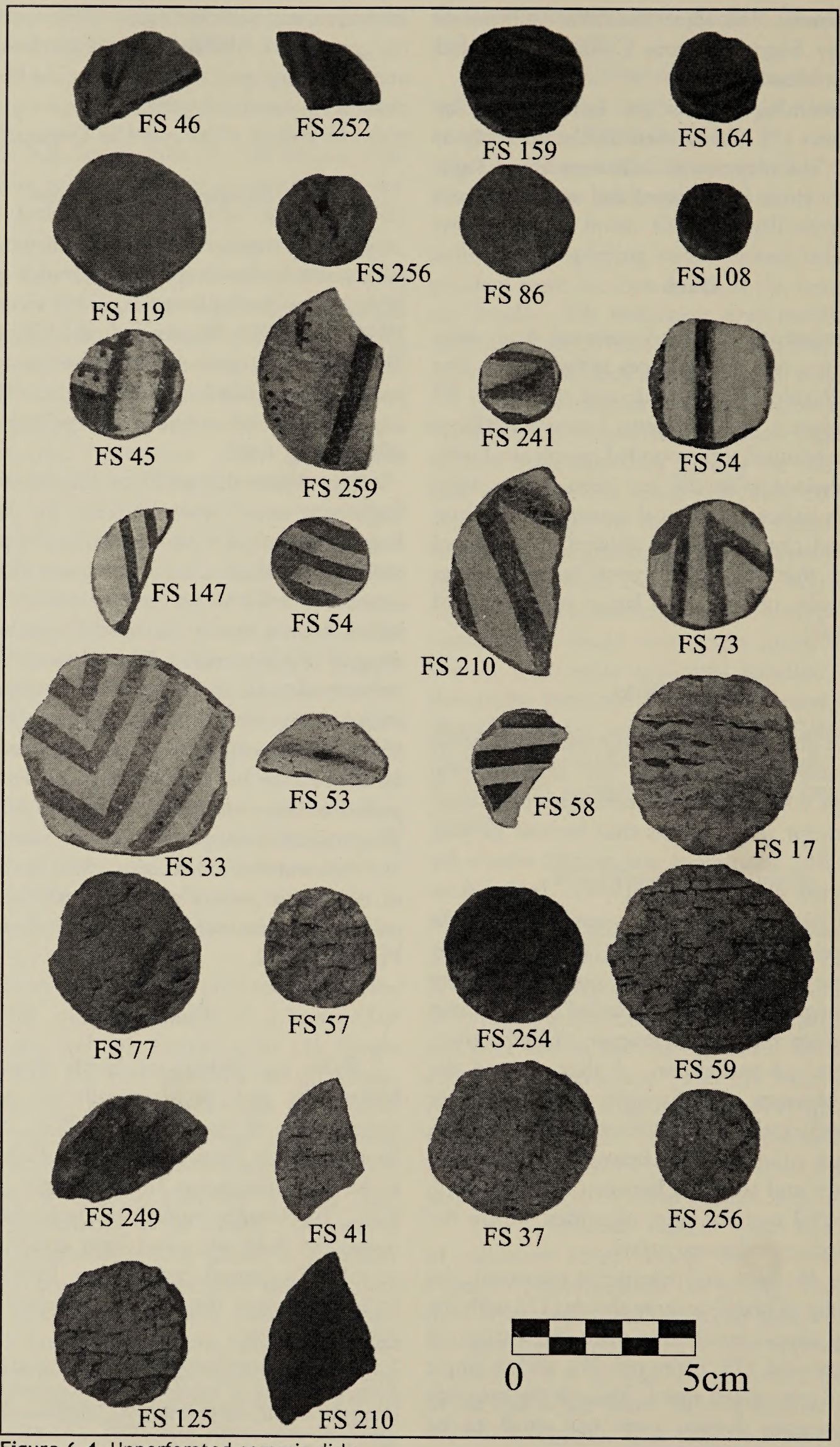


Figure 6.4. Unperforated ceramic disks.

Figure 6.5. Perforated ceramic disks.

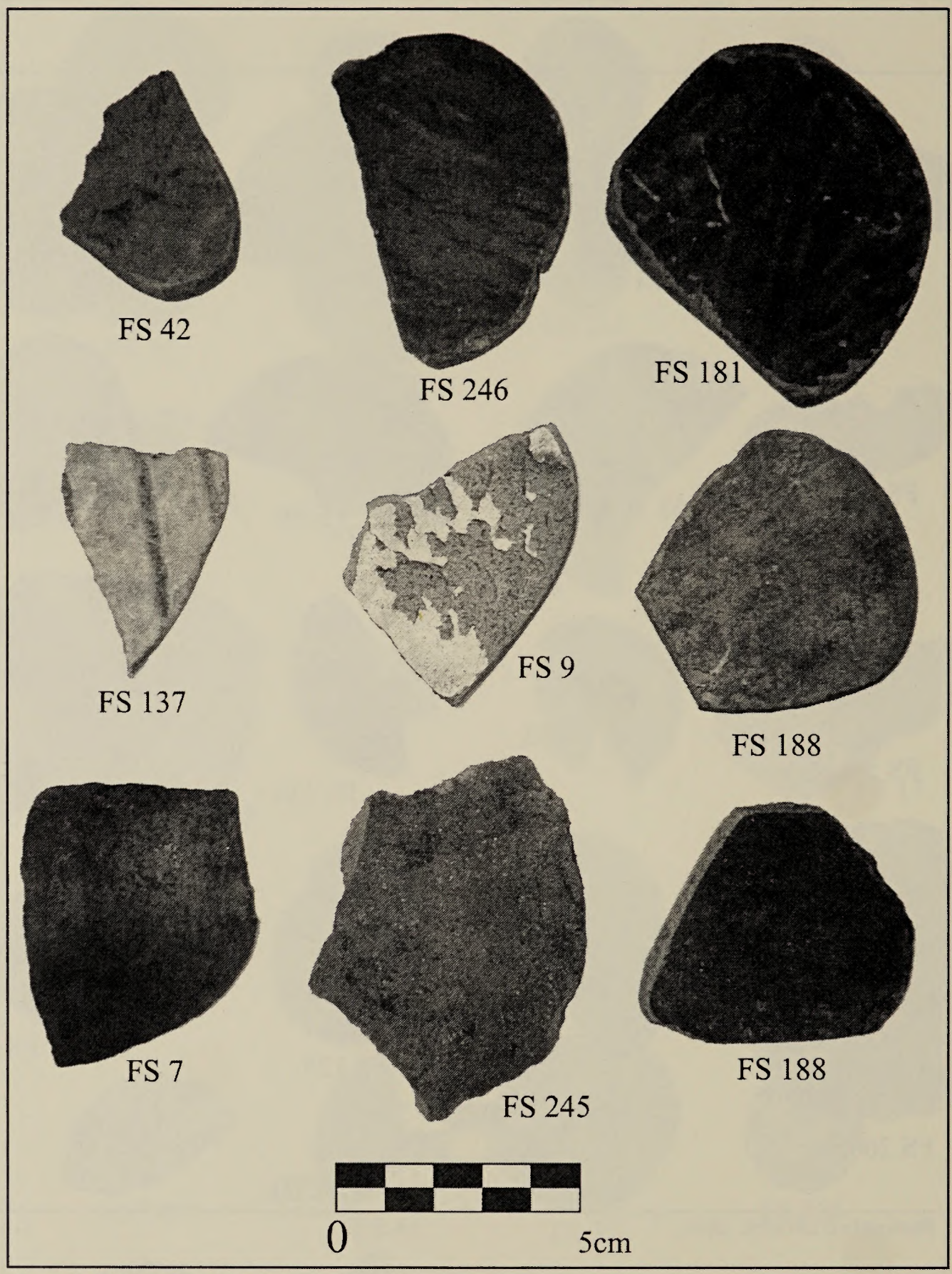


Figure 6.6. Modified sherds

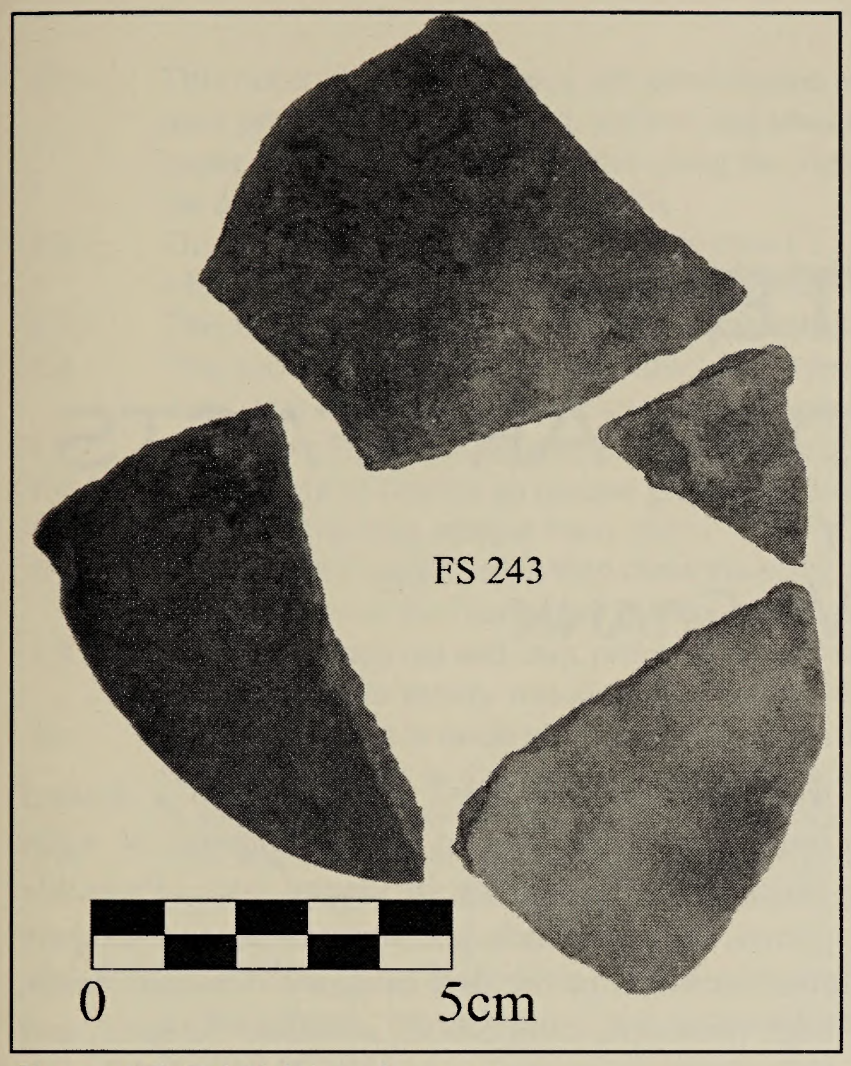


Figure 6.7. Puki/platter fragments.

More complete examples of this form from Littlecreek Mesa (42Ws881, 42Ws920) and Colorado City (2Mo869) are also made from the bases of broken vessels. All have displayed similar edge modification, and all appear to be roughly the same size (15-16 cm diameter). The similarity of these objects leads me to infer that they are indeed a separate class of artifact that may or may not have functioned as pukis. Distinctive shoulders on vessels are usually associated with use of a puki in certain New Mexico ceramics (Peckham 1990: 116). However, this may be a stylistic or functional trait rather than one mandated by the puki.

Edge-modified Sherds

This is the residual category for edge-modified sherds that are small, lacking curvature sufficient for a disk, or oddly shaped objects that exhibit an edge ground at 90° to the surfaces (Fig. 6.6). All three objects (FS7, FS245, FS188) in this category could represent fragments of groups previously discussed (e.g., unused edges of formally prepared scrapers), or could represent objects of no known analogue. All three objects were recovered from a single context (Pit Structure 1).

Chapter 7
Analysis of Lithic Artifacts
by
Barbara W. Frank

A total of 1978 pieces of modified and unmodified stone were recovered from 42Ka3976. Some 583 pieces, or 29% of the collection, were classified as tools. A tool was identified by the presence of intentional flaking meant to modify the shape of the object, or by the presence of use-wear marks caused by varying types of cultural manipulation. The remaining 1395 pieces in the collection were classified as forms of flaking refuse. All pieces were initially classified as to material type, and then examined with a 20X binocular microscope for evidence of use or other cultural manipulation. Full discussions of topological divisions and waste flake classification are included in the following sections.

A lithic material typology was devised in order to evaluate possible correlations between tool categories and material types, and to examine raw material procurement strategies. The artifacts were divided into material types, including chert, petrified wood, sandstone, quartzite, and basalt. The cherts were further subdivided on the basis of color and/or opaqueness, and designated as types C1, C2, C3 etc. Type C1 is a local variety, as it occurs in the Chinle Formation. Sources of this material, also referred to as jasper, are exposed in the immediate area, primarily along the base of the Vermilion Cliffs (Walling et al. 1986; Walling and Thompson 1986, 1988; Dalley and McFadden 1988; Frank 1997). The definitions of each of these material types are shown in Table 7.1.

The 538 pieces of modified stone were divided into two basic categories. The first group of tools was those manufactured by flaking to a desired form, while the second group consists of tools which were formed by incidental use. Projectile points, knives, bifaces, preforms, drills, and scrapers were included in the first category. Utilized flakes, edge pounders, core, cobble, and flake scrapers, and hammerstones comprise the second group. All tools were classified according to traditional typologies (Walling et al. 1986; Walling and Thompson 1986; Dalley and McFadden 1988; Frank 1997), and by the identification of morphological and visible functional attributes.

CHIPPED STONE TOOL TYPE DEFINITIONS AND DESCRIPTIONS

Projectile Points

Projectile points are those artifacts that have been bifacially modified to a preconceived stylistic design. These forms generally exhibit two basic elements. The first is a large blade which is the piercing portion of the implement; the second is a hafting element which takes the form of a basal stem or modification of the blade base. The two major forms of projectile points are dart points and arrow points. These are distinguished largely on the basis of size and stylistic differences. Arrow points, in addition, can be distinguished by the presence of pressure retouch flaking, low edge-angle range, and their relative thinness. The noted differences between dart points and arrow points, however, do not necessarily imply

C1 -	This material may be colored any combination of red, yellow, black, translucent gray or opaque white. The most prevalent colors are red, yellow, and translucent grays. This material type is most commonly called jasper, and there are local sources along the Vermilion Cliffs, occurring in the Chinle Formation. This was the dominant material at 42Ka3976.
C2 -	This variety of chert may be related to type C1. It exhibits color combinations of pinks, grays, black and white. It is the second most common type recovered from 42Ka3976.
C3 -	This is an opaque variety, including combinations of yellow, brown and gray.
C4 -	This variety includes white and white/gray types. It is generally common in the Virgin Anasazi area to the west. It is the third most represented chert type at this site and is available in the Kaibab Formation.
C5 -	A chert variety including gray to dark gray color combinations.
C6 -	This variety of chert is an opaque gray and white type.
C7 -	This material is an opaque black chert.
C8 -	A translucent variety exhibiting dendritic black inclusions. This variety is similar to that noted at the Brian Head source, on the Markagant Plateau to the northwest.
C9 -	An opaque deep red and dark yellow chert variety, with a source in the Escalante area. A single tool fragment of this variety was identified in the collection.
B -	This designation is made up of gray fine-grained basalt. These materials would have been available in volcanic outcrops to the north and northwest of the project area.
L -	A single piece of white/gray silicified limestone was observed in the collection.
PW -	This material is a fine to coarse grained petrified wood, primarily white and brown in color, but also including black, red and orange. It is found locally within both the Shinarump and Petrified Forest Members of the Chinle Formation.
Q -	Quartzite is found in the form of cobbles throughout the local Quaternary gravels. It varies widely in color, including gray, brown, yellow, and purple varieties. Quartzite cobbles would have been locally available in alluvial deposits.
SS -	This designation refers to fine- to coarse-grained sandstone, varying widely in color and composition. This material is locally available along the canyon cliffs.

Table 7.1. Lithic material type definitions.

that they did not overlap temporally. In particular, the Elko series dart points are frequently found in association with post-Archaic assemblages.

A total of twenty-two projectile points were identified within the collection from this site, including 14 diagnostic types and 8 fragments. A single dart point, a Pinto type, was recovered, and the remaining 13 arrow points are representative of the Puebloan occupation of the site.

Pinto type

One possible Pinto dart point was recovered from this site. It is fairly small and it has been crudely worked, exhibiting some limited unifacial retouch along the laterals (Fig. 7.1A). The constricting stem makes up approximately one-third of the total length. It measures 3.37 cm long by 1.53 cm wide, at the shoulders, to 1.06 cm wide, at the stem base, and it ranges from .07 to .62 cm thick. The stem base exhibits a very slight concavity, and the tip is missing. This may well be a prehistorically curated specimen, as Pinto points are diagnostic of the late Archaic period, ca 5500 to 2000 B.P. in the southern Great Basin (Walling et al. 1986). It was recovered from the F2 midden at BB-19, and it is composed of type C6 chert.

Rose Spring Corner-notched

One finely worked Rose Spring Corner-notched arrow point was recovered from a depth of 65 to 85 cm in A-18. The Rose Spring variant is apparently the earliest arrow point in the region, dating from A.D. 300 to 500 through A.D. 950, and associated with Basket Maker III and Pueblo I occupations (Holmer and Weder 1980; Walling et al. 1986). This specimen has been bifacially retouched, and part of one lateral and tang has broken off (Fig. 7.1B). It exhibits a parallel-sided straight stem, with one extending tang, and it is made of type C1 chert. It measures 3.11 cm long and ranges from .03 to .34 cm thick.

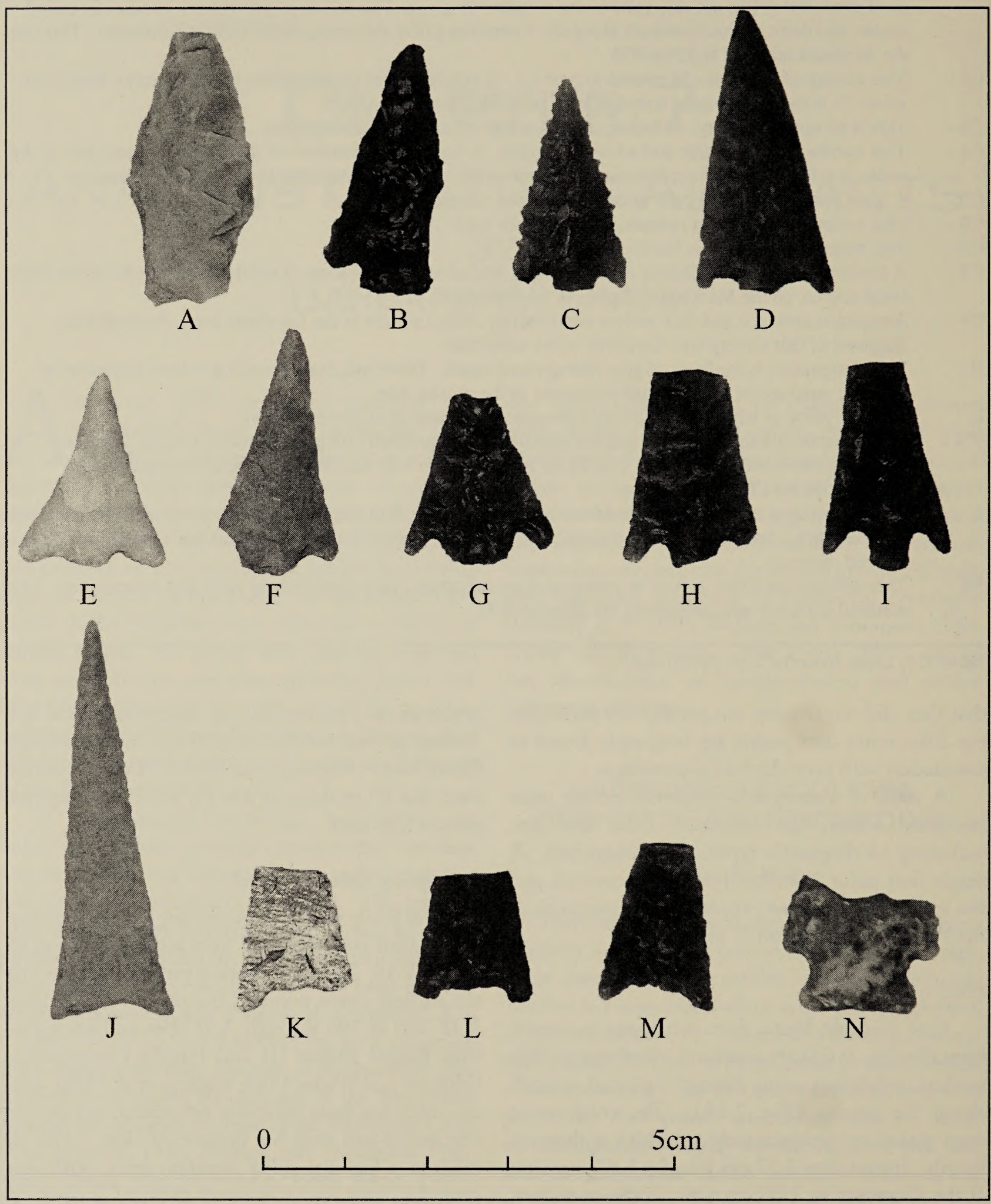


Figure 7.1. Projectile points: (A) Pinto dart point; (B) Rose Spring Corner-notched; (C-I) Parowan Basal-notched; (J-M) Bull Creek; (N) Unidentified corner-notched.

Parowan Basal-notched

Seven arrow points of this type were identified within the lithic tool collection from 42Ka3976. Three are complete specimens, while the four fragments lack only the tip section of the blade. On the Colorado Plateau and in the Virgin Anasazi region, this type dates between AD 950 and 1150, and within the Virgin Anasazi area, they are the predominant type during the Pueblo II period (Holmer and Weder 1980; Walling et al. 1986).

The first complete example is composed of type C1 chert, and it has been thoroughly bifacially retouched and thinned (Fig. 7.1C). The retouch has formed serrations along the convergent laterals, but some of the original flake curvature is still extant. It measures 2.65 cm long by 1.39 cm wide, at the shoulders, and from .04 to .26 cm thick. This point was recovered from Grid F17, at a depth of 80 to 100 cm. The second, largely complete Parowan Basal-notched point exhibits a snap fracture along the basal stem (Fig. 7.1D). It has been thoroughly bifacially retouched and thinned; it was recovered from F5 looter's backdirt. It is composed of type C1 chert and it measures 3.52 cm long by 1.68 cm wide, at the base, and it ranges from .03 to .26 cm thick. The third whole point of this type is a smaller specimen, which is generally asymmetrical, exhibiting somewhat splayed shoulder tangs (Fig. 7.1E). It displays concave, convergent laterals, and it has been throughly bifacially retouched and thinned. This point measures 2.43 cm long by 1.82 cm wide, at the basal shoulders, and it ranges from .04 to .35 cm thick. It was recovered from a depth of 40 to 65 cm in A-18.

Three of the incomplete Parowan Basal-notched points are composed of type C1 chert, and one is type C6 chert. This latter specimen was recovered from spoil in the vicinity of Pit Structure 2. It is lacking one shoulder and its associated tang, and it has also been completely bifacially worked, retouched, and thinned (Fig. 7.1F). It measures 3.03 cm long by a maximum of 1.49 cm wide, along the blade mid-section, and it ranges from .05 to .25 cm thick.

All three of the type C1 chert points are missing the blade tip element. The first has been fully bifacially worked and thinned, and it displays extended shoulder tangs (Fig. 7.1G). It measures 2.09 cm long, incomplete length, by 1.82 cm wide, at the base, and it ranges from .10 to .31 cm thick. It was recovered from the 250 to 270 cm level in Pit Structure 2. The next specimen exhibits an impact fracture at the tip (Fig. 7.1H). It has been bifacially worked and thinned, and it was recovered from E17, at a depth of 80 to 100 cm. It measures 2.3 cm long, incomplete length, by 1.63 cm wide, at the base, and from .06 to .32 cm thick. The final point of this type exhibits deep basal notches, extending tangs and a straight stem (Fig. 7.1I). It has been thoroughly bifacially worked and thinned, and it was recovered from a depth of 100 to 120 cm in Pit Structure 3. This artifact measures 2.54 cm long, incomplete length, by 1.57 cm wide, basal measurement, and it ranges from .07 to .34 cm thick.

Bull Creek

Five Bull Creek arrow points, one complete and four basal fragments, were recovered from this site. These points are generally associated with the Kayenta Anasazi, but they are also found in both Virgin Anasazi and Fremont contexts. They are generally related to late Pueblo II occupations in the Virgin Anasazi region (Holmer and Weder 1980; Walling et al. 1986).

The single complete specimen is composed of type C2 chert and it was recovered from the 50 to 60 cm level in A-17. It has been finely bifacially retouched and thinned, and it exhibits almost non-existent basal tangs (Fig. 7.1J). It measures 4.87 cm long by 1.52 cm wide, at the base, and it ranges from .05 to .29 cm thick. The first fragment is composed of type C2 chert, and it represents the base and lower blade element, lacking one basal tang. It has been finely bifacially retouched and thinned, and it was also recovered from A-17, at a depth of 60 to 80 cm. It measures 1.62 cm long, incomplete length, by .87 cm wide, at the blade mid-section, and it ranges from .08 to .36 cm thick.

The next basal fragment was also composed of type C2 chert (Fig. 7.1K). It has been finely bifacially retouched and thinned, measuring 1.78 cm long, incomplete length, by 1.38 cm wide, at the shoulders, and ranging from .03 to .34 cm thick. This fragment, and the next artifact, were both recovered from a depth of 90 to 110 cm in F2 at CC-19 and CC-20. The following specimen is composed of type C1 chert. The basal tangs are somewhat asymmetrical, but the remnant has been finely bifacially retouched and thinned (Fig. 7.1L). It lacks the upper blade and

tip portion, and it measures 1.61 cm long, incomplete length, by 1.44 cm wide, at the base, and from .03 to .27 cm thick.

The last Bull Creek basal fragment is composed of type C1 chert. It has been finely bifacially retouched and thinned, and it exhibits an impact fracture near the tip (Fig. 7.1M). The basal concavity is slightly angled. This fragment measures 1.99 cm long, incomplete length, by 1.41 cm wide, at the base, and it ranges from .05 to .34 cm thick. This artifact was recovered from the fill of Pit Structure 1, at a depth of 120 to 140 cm.

Non-diagnostic Arrow points and Fragments

Two non-diagnostic points were found, both with expanded stems. One is a corner-notched, shouldered, stemmed point composed of type C5 chert (Fig. 7.1N). It has been bifacially worked and thinned, but it exhibits limited retouch. This fragment lacks the majority of the blade, measuring 1.62 cm long, incomplete length, by 1.91 cm wide, at the shoulders, to 1.46 cm wide, along the basal stem, and it ranges from .08 to .37 cm thick. The second point is a side-notched, expanding stem specimen exhibiting a triangular blade element, lacking the extreme tip. It has been completely bifacially retouched and thinned, and it is composed of type C4 chert. It was recovered from the 90 to 110 cm level in Stratum 2 at CC-19 and CC-20. This artifact measures 2.54 cm long, incomplete length, by 1.32 cm wide, along the stem, to 1.51 cm wide, at the shoulders, and it ranges from .05 to .35 cm thick.

Six non-diagnostic arrow point fragments were distinguished within the lithic tool collection. Two are blade mid-section fragments, two are blade tip fragments and two are blade fragments. The first blade section is composed of type C2 chert and it has been completely bifacially worked and thinned. It measures 1.98 cm long, incomplete length, by a maximum of 1.26 cm wide and it ranges from .47 to .8 cm thick. This artifact was recovered from the F2 midden at BB-19, in the 90 to 110 cm level. The next blade fragment exhibits a snap fracture along the base, and the tip is also missing (Fig. 7.2A). It measures 3.02 cm long, incomplete length, by 1.55 to 1.79 cm wide and it ranges from .01 to .34 cm thick. It is composed of type C2 chert, and it has been bifacially worked and thinned. This fragment was recovered from a depth of 65 to 85 cm in A-18.

The two blade mid-section fragments are both composed of type C1 chert. The first was recovered from Pit Structure 2 (F2 midden) in CC-19. It has been thoroughly bifacially worked, retouched and thinned, and it exhibits convergent laterals. This fragment measures 1.3 cm long, incomplete length, by 2.05 cm wide and it ranges from .07 to .41 cm thick. The second mid-section fragment is completely bifacially retouched and thinned. It measures 1.42 cm long, incomplete length, by 1.26 cm wide and from .01 to .32 cm thick. It was recovered from a depth of 60 to 80 cm in A-17.

One blade tip fragment is composed of type C1 chert, and it was recovered from Stratum 2 at CC-19 and CC-20, in the 90 to 110 cm level. It has been thoroughly bifacially retouched and thinned, exhibiting convergent laterals (Fig. 7.2B). It measures 1.4 cm long, incomplete length, and it ranges from .07 to .79 cm thick. The final arrow point fragment was recovered from a depth of 160 to 180 cm in Pit Structure 3. It is composed of type C3 chert, and it exhibits bifacial retouch along the convergent laterals (Fig. 7.2C). It measures 2.78 cm long, incomplete length, by a maximum of 1.17 cm wide, and it ranges from .05 to .27 cm thick.

Knives and Bifaces

Bifaces are those artifacts which exhibit hard hammer, soft hammer, and pressure flaking on both surfaces of flakes that have, in most instances, been struck from prepared cores. Among the bifacially worked forms recovered during these excavations were knives and fragments, bifaces and an eccentric item.

Knives are bifacially modified tools that exhibit pressure retouch on the margins and surfaces of the completed artifacts. These implements may or may not have been hafted, but in either instance, they were used for cutting or slicing a variety of materials. Knives often exhibit a wear polish on the margins, indicating use to cut soft materials. In other cases, however, the margins may have a ground appearance suggesting contact with more resistant materials. Six complete knives, two knives suitable for hafting, ten basal fragments, eight tip fragments, and six mid-section fragments were distinguished in the lithic tool collection from this site.

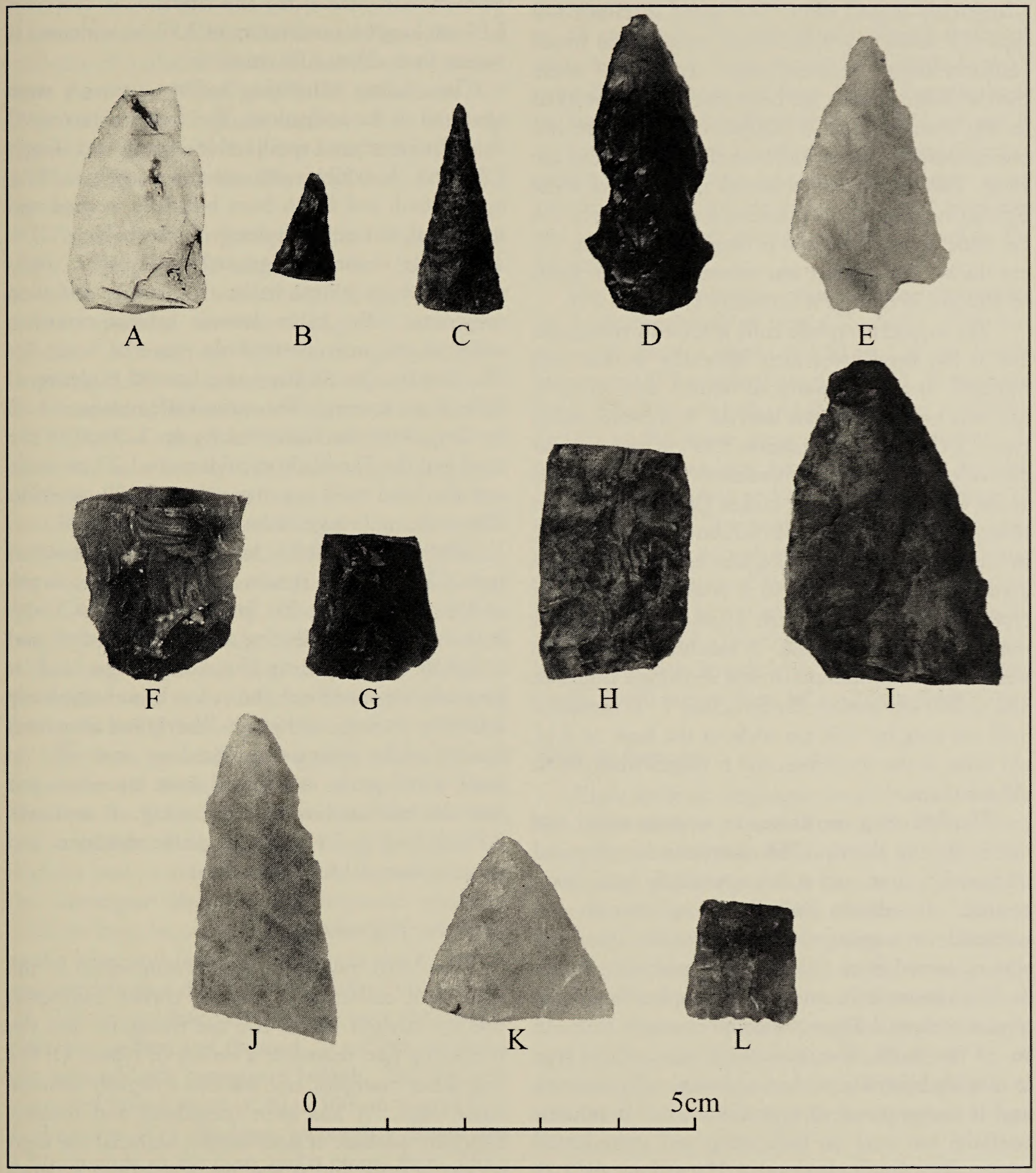


Figure 7.2. Kinives and bifaces: (A-C) fragments; (D-E) hafted knives; (F-H) knife base fragments; (I-K) knife tip fragments; (L) preform.

Complete knives

The first three complete knives are generally triangularly shaped tools. The initial specimen is a type C3 secondary flake which exhibits the intact platform along the basal edge. It displays some bifacial flaking and it has been more heavily worked on the dorsal surface. It exhibits one excurvate and one convergent lateral, and both display unifacial use wear. Part of one lower lateral also displays some bifacial use scarring. It measures 6.68 cm long by 3.4 cm wide, at the base, and it ranges from .17 to .97 cm thick. This artifact was recovered from a depth of 100 to 120 cm in Pit Structure 1, at Grid F16.

The second complete knife is roundly triangular, and it has been completely bifacially worked and thinned. It exhibits unifacial retouch and unifacial use wear on the excurvate laterals. It is composed of type C1 chert, and it measures 3.99 cm long by 1.83 cm wide, at the base, to a maximum of 2.93 cm wide, at the mid-section, and it ranges from .12 to .54 cm thick. It was recovered from fill above Pit Structure 1 in Grid F17. The third triangular knife is somewhat asymmetrically shaped, and it is also composed of type C1 chert. It has been bifacially worked, but not retouched or thinned. It exhibits unifacial use wear on the laterals, and it was recovered from the 180 to 200 cm level in Pit Structure 1. It measures 3.25 cm long by 1.84 cm wide, at the base, to 2.11 cm wide, at the shoulders, and it ranges from .06 to .63 cm thick.

The following two knives are ovate in shape, and one is lacking the tip. This specimen is composed of type C5 chert and it has apparently been heat-treated. It exhibits limited bifacial retouch and unifacial use scarring along the laterals. This knife was recovered from the floor of Residential Room 1. It measures 2.91 cm long, incomplete length, by a maximum of 2.24 cm wide and it ranges from .16 to .61 cm thick. The second specimen of this type is roughly bifacially worked and minimally thinned, and it is composed of type C3 chert. It exhibits unifacial use wear on both steep and acute lateral edges. This knife measures 4.53 cm long by 2.29 cm wide, at the base, to 3.39 cm wide, at the mid-section, and it varies from .2 to 1.03 cm thick. It was recovered from general F37 fill.

The next knife is a tear-drop shaped tool composed of type C1 chert. It has apparently been heat-treated, and it was recovered from the floor of Residential Room 1. This tool has been minimally bifacially worked and thinned, and it exhibits unifacial use wear along the laterals. It measures 5.07 cm long by a maximum of 3.57 cm wide and it ranges from .22 to 1.05 cm thick.

Two knives exhibiting hafting elements were observed in the collection. The first was recovered from Pit Structure 1 spoil, and it is composed of type C1 chert. It exhibits side notches roughly halfway up the tool, and it has been bifacially worked and retouched, but not completely thinned (Fig. 7.2D). The blade element is generally triangular, while the basal stem widens below the notches and then constricts. The blade laterals exhibit extensive unifacial use wear, particularly near the acute tip. The laterals also display some limited evidence of bifacial use scarring. The entire knife measures 4.03 cm long, with the blade making up 2.23 cm of the total length. The blade shoulders are 1.73 cm wide and the basal stem is a maximum of 1.82 cm wide. The entire tool ranges from .08 to .38 cm thick.

The second haftable knife is also composed of type C1 chert, and it was recovered from a depth of 155 to 165 cm in Pit Structure 2 fill at CC-19. It is shouldered, exhibiting a constricting stem and a slightly constricted tip (Fig. 7.2E). The blade is generally asymmetrical and it has been completely bifacially worked and thinned. The tip and associated laterals exhibit extensive unifacial use wear. The tip itself is still acute, and the adjacent lateral on one side also exhibits bifacial use scarring. It measures 3.79 cm long by 2.13 cm wide, at the shoulders, and it varies from .01 to .43 cm thick.

Knife base fragments

Ten basal fragments were distinguished in the lithic tool collection. Two are corner fragments, two are straight-based, two are triangular and the remaining four represent a variety of types. Of the four latter examples, one exhibits a slightly concave basal edge. It has been irregularly and roughly bifacially worked. It does exhibit unifacial use wear on the laterals, and it was recovered from a depth of 110 to 130 cm in Pit Structure 2 (F2 midden) at CC-19. This fragment is composed of type C1 chert and it measures 2.02 cm long, incomplete length, by 2.05 cm wide, along the base, and it ranges from .09 to .39 cm thick.

One type C1 chert fragment displays a constricted base and excurvate laterals. It has been bifacially worked and thinned, and it exhibits a snap fracture across the blade. The laterals display limited evidence of unifacial use wear, and it was recovered from the 60 to 80 cm level in F2 midden at B17 (Fig. 7.2F). This fragment measures 2.52 cm long, incomplete length, by 1.68 cm wide, at the base, to 2.25 cm wide, at the shoulders, and from .05 to .58 cm thick.

The next two fragments exhibit angled basal edges. The type C3 chert tool has been finely bifacially retouched and thinned (Fig. 7.2G). It exhibits unifacial use wear along the convergent laterals. It measures 1.94 cm long, incomplete length, by 1.72 cm wide, basal width, and from .06 to .47 cm thick. It was recovered from F2 at CC-19 and CC-20, at a depth of 90 to 110 cm. The second specimen is a heavily used, rectangular fragment exhibiting an angled basal edge (Fig. 7.2H). It has been finely bifacially worked and thinned, and it exhibits extensive unifacial, and more limited bifacial, use wear along the extant laterals. It is composed of type C9 chert, measuring 3.09 cm long, incomplete length, by 1.44 cm wide, basal width, to 1.92 cm wide, along the blade, and it ranges from .03 to .36 cm thick. It was recovered from Storage Room 1 fill during its initial clean-up, in the upper 10 to 15 cm.

The two, generally triangularly shaped, basal fragments are both composed of type C1 chert. The first has been bifacially worked and thinned, and it exhibits a snap fracture along the blade. It displays both unifacial and bifacial use wear along the convergent laterals. This fragment measures 2.02 cm long, incomplete length, by 2.05 cm wide, at the base, and from .09 to .39 cm thick. It was recovered from a depth of 80 to 100 cm in grid E-14. The second fragment has also been thoroughly bifacially worked and thinned. It exhibits unifacial use wear on both convergent laterals. The tool was recovered from a depth of 80 to 100 cm in grid F17. It measures 2.11 cm long, incomplete length, by 2.57 cm wide, at the base, and it ranges from .08 to .46 cm thick.

One of the straight-based knife fragments was recovered from a depth of 50 to 60 cm in Grid B17, and it is composed of type C2 chert. It has been roughly bifacially worked and fairly well-thinned, exhibiting natural irregularities on one surface. This tool displays unifacial use wear along both laterals. It measures 1.61 cm long, incomplete length, by a maximum of 3.3 cm wide and it ranges from .07 to .58 cm thick. The next straight-based fragment measures 2.17 cm long, incomplete length, by 1.61 cm wide, at the base, and from .07 to .4 cm thick. It has been finely bifacially worked and thinned, and it is composed of type C5 chert. The straight laterals exhibit unifacial use scarring, along with some grinding on part of one edge. This tool fragment was recovered from the 120 to 140 cm level in Pit Structure 3.

The two remaining basal corner fragments are both composed of type C1 chert. One was recovered from a depth of 110 to 130 cm in Pit Structure 2 (F2 midden) in grid BB-19. It has been finely bifacially worked and thinned, and it exhibits limited unifacial use wear near to the corner. It measures 2.58 cm long, incomplete length, by 2.46 cm wide, incomplete width, and it ranges from .12 to .65 cm thick. The final fragment, a basal corner piece, has been completely bifacially worked and thinned. It displays unifacial use wear on the extant lateral edge, and it was recovered from the 60 to 80 cm level in A-17. This fragment measures 1.55 cm long, incomplete length, by 1.2 cm wide, incomplete width, and it ranges from .08 to .34 cm thick.

Knife tip fragments

Eight knife tip fragments were identified within the lithic tools recovered from 42Ka3976. They were all recovered from fill situations and all exhibit evidence of unifacial use wear on one or more extant laterals. Only one displays evidence of bifacial use wear, and it is a larger tip fragment exhibiting excurvate laterals (Fig. 7.2I). It has been heavily used, and both laterals exhibit extensive unifacial use wear. It measures 4.26 cm long, incomplete length, by a maximum of 2.94 cm wide and from .07 to .68 cm thick. It was recovered from a depth of 100 to 120 cm in Pit Structure 3, and it is composed of type C2 chert.

The type C5 chert fragment has been roughly bifacially worked and thinned. It has one convergent and one excurvate lateral, and the latter exhibits unifacial use wear. It was recovered from Pit Structure 3 fill, and it measures 2.79 cm long, incomplete length, by a maximum of 2.25 cm wide and from .11 to .44 cm thick. The next fragment has

been bifacially worked and thinned, and it displays generally convergent laterals (Fig. 7.2J). These edges exhibit sporadic unifacial use wear, as does the tip. It measures 4.04 cm long, incomplete length, by 1.79 cm wide and it varies from .05 to .6 cm thick. This fragment is composed of type C6 chert and it was recovered from F2 midden in B17, at a depth of 60 to 80 cm.

The remaining five fragments are all composed of type C1 chert. The first has asymmetrical laterals which exhibit evidence of unifacial use wear. It was recovered from a depth of 60 to 80 cm in grid A-17 and it ranges from .07 to .34 cm thick. The next specimen is roughly worked and not well thinned, and it exhibits unifacial use wear along the laterals. It measures 1.84 cm long, incomplete length, by a maximum of 1.42 cm wide and from .08 to .55 cm thick. This fragment was recovered from grid A-17, in the 60 to 80 cm level. The third tip fragment is a fairly well-worked specimen exhibiting asymmetrical laterals which display unifacial use wear. It measures 2.33 cm long, incomplete length, by a maximum of 1.78 cm wide and from .11 to .42 cm thick. This fragment was recovered from the Pit Structure 2 (Stratum 2) in grid CC-19.

The two remaining type grid C1 chert fragments are both larger knife tips. One has been thoroughly bifacially retouched and thinned, and it displays unifacial use wear along one of the asymmetrical laterals. It measures 3.65 cm long, incomplete length, by a maximum of 3.07 cm wide and it ranges from .11 to .65 cm thick. It was recovered from a depth of 145 to 155 cm in grid CC-20. The final fragment is a finely bifacially worked and thinned tool (Fig. 7.2K). It exhibits excurvate laterals which display extensive unifacial use wear, and it was recovered from Stratum 2 in grid CC-19 and CC-10, at a depth of 90 to 110 cm. This fragment measures 2.38 cm long, incomplete length, by 2.42 cm wide and it varies from .03 to .55 cm thick.

Knife mid-section fragments

Six mid-section fragments, five composed of type C1 chert and one of type C4 chert, were distinguished in the collection. The type C4 chert fragment is a portion of the upper blade, and it has been bifacially worked and thinned. It exhibits unifacial use wear and it was recovered from the Stratum 2 midden in grid BB-19 at a depth of 90 to 110 cm. It measures 1.4 cm long, incomplete length, by 1.21 cm wide and .12 to .26 cm thick. The first of the type C1 chert specimens is finely bifacially worked and thinned. It exhibits convex laterals which display moderate unifacial use wear. It measures 3.78 cm long, incomplete length, by 2.35 cm wide and from .09 to .56 cm thick. This fragment was recovered from spoil in front of and near the Pit Structure 1 floor level. The next fragment is an upper blade section, which is twisted and asymmetrical. It exhibits crushing and grinding on the laterals, and it was recovered from a depth of 120 to 140 cm in Pit Structure 1. This fragment measures 4.68 cm long, incomplete length, by a maximum of 2.28 cm wide and from .18 to 1.03 cm thick.

The next specimen is a roughly bifacially worked, irregularly shaped mid-section fragment. It exhibits limited unifacial use wear along one lateral, and it measures 2.13 cm long, incomplete length, by a maximum of 1.67 cm wide and from .07 to .37 cm thick. Both this fragment and the following one were recovered from the 60 to 80 cm level in grid A-17. The next specimen is an irregularly shaped fragment, exhibiting one convex and one excurvate lateral. The convex lateral displays unifacial use wear, as well as some edge grinding. It measures 1.82 cm long, incomplete length, by a maximum of 1.95 cm wide and from .05 to .46 cm thick. The final mid-section fragment is an irregular piece, exhibiting only one intact lateral. The edge displays some limited unifacial use wear, and it was recovered from the F2 midden in B-17 at a depth of 60 to 80 cm. It ranges from .04 to .28 cm thick.

Biface fragments

A largely complete, leaf-shaped biface was recovered from Pit Structure 2 fill at a depth of 185 to 200 cm. Part of one excurvate lateral is missing, and the remaining portion has been completely bifacially worked and thinned. It measures 4.25 cm long by 1.94 cm wide, at the shoulder area, and from .12 to .66 cm thick.

The remaining eight biface fragments include six basal sections, one tip and one mid-section fragment. The first basal specimen is a tiny broken fragment composed of type C5 chert. It was recovered from general Pit Structure 2 fill. The second fragment is finely bifacially retouched and thinned. It exhibits a straight basal edge and straight laterals. This

fragment measures 2.29 cm long, incomplete length, by 2.35 cm wide, at the base, and it ranges from .11 to .47 cm thick. It is composed of type C3 chert.

The next four basal fragments are composed of type C1 chert. The first consists of a convex basal edge, with associated straight laterals. These have been unifacially retouched, and this specimen was recovered from 80 to 100 cm in grid B-17. It measures 1.86 cm long, incomplete length, by 1.68 cm wide and it ranges from .11 to .41 cm thick. The next fragment was recovered from a depth of 60 to 80 cm in grid A-17. It has been completely bifacially worked and thinned, but it displays minimal retouch along the divergent laterals. It measures 1.72 cm long, incomplete length, by a maximum of 2.28 cm wide and from .12 to .43 cm thick.

The last two type C1 chert specimens are corner fragments. One is a finely bifacially retouched and thinned tool. It measures 2.25 cm long, incomplete length, by 1.92 cm wide, incomplete width, and it ranges from .15 to .49 cm thick. It was recovered from grid CC-20, in the 145 to 155 cm level. The last fragment is a tiny piece, varying from .12 to .42 cm thick. It was recovered from a depth of 90 to 110 cm in the F2 midden at Pit Structure 2, in grid CC-20.

The single bifacially worked tip fragment is composed of type C5 chert. It exhibits a blunt tip and convergent laterals, and it was recovered from a depth of 80 to 100 cm in E-14. This fragment measures 1.68 cm long, incomplete length, by a maximum of 1.24 cm wide and it ranges from .12 to .48 cm thick.

The only mid-section fragment exhibits generally convergent laterals, which have been minimally bifacially retouched. It measures 1.64 cm long, incomplete length, by a maximum of 2.22 cm wide and it ranges from .04 to .47 cm thick. This fragment was recovered from F16 at a depth of 80 to 100 cm.

Eccentric

This artifact is a finely bifacially worked, retouched and thinned, generally triangular-shaped specimen. A small point has been worked at the tip of the triangle, and side-notches are present which define its length. The point makes up roughly .84 cm of the total 3.08 cm length. The base of the artifact measures 1.83 cm wide and it ranges from .07 to .48 cm thick. This specimen exhibits no evidence of use, and it is composed of type C2 chert. It was recovered from a depth of 160 to 180 cm in Pit Structure 1 fill.

Preforms

Preforms are bifacially worked artifacts, exhibiting both hard and soft hammer flaking patterns, which represent an intermediate step in the tool production sequence, between flake production and finished specimen. Arrow point preforms, in particular, may display bifacial and/or unifacial retouch and low edge angles (Walling et al. 1986).

Four bifacially worked preforms and two preform basal fragments were identified. The basal fragments both appear to be from arrow point preforms. One of these is a straight-based portion which has been thoroughly bifacially worked, retouched, and thinned. It is composed of type C1 chert and it measures 1.54 cm long, incomplete length, by 1.52 cm wide, basal measurement, and it ranges from .01 to .33 cm thick. It was recovered from the 90 to 110 cm level within Statum 2 at grid CC-19 and CC-20. The second specimen is lacking the tip and one basal corner, and it is composed of type C2 chert. The entire artifact has been bifacially worked and thinned, and it could be Bull Creek preform. It measures 3.03 cm long by 1.28 cm wide, at the base, and it ranges from .12 to .41 cm thick. This specimen was recovered from a depth of 80 to 100 cm in grid F17.

The four generally complete specimens, discussed above, are less well-worked and thinned, than the apparent arrow point preforms. The first is a generally triangularly shaped example, lacking a basal corner and the tip (Fig. 7.2L). It has been roughly bifacially worked and the original flake curvature is still extant. It measures 2.42 cm long, incomplete length, by an average of 1.21 cm wide and it varies from .07 to .27 cm thick. This artifact was recovered from a depth of 90 to 110 cm in Stratum 2 at grid CC-19 and CC-20, and it is composed of type C6 chert. The next specimen is a roughly bifacially worked ovate-triangularly shaped artifact, composed of type C3 chert. It measures 3.99 cm long by a maximum of 2.84 cm wide and it ranges from .16 to .82 cm thick. It has been minimally thinned and it was recovered from general F37 fill.

The last two preforms are composed of type C1 chert. One is a largely complete, heat-treated

specimen which exhibits a broken lateral and some surface spalling. It has been bifacially worked and thinned, and it was recovered from a depth of 50 to 60 cm in grid A-17. This preform measures 3.26 cm long by 1.33 cm wide, at the base, and it ranges from .07 to .46 cm thick. The final preform was recovered from Pit Structure 2 fill in grid CC-19 at a depth of 155 to 165 cm. It is irregularly ovate in shape, measuring 3.26 cm long by a maximum of 1.75 cm wide and ranging from .12 to .73 cm thick. It has been roughly bifacially worked and thinned.

Drills

Drills are tools characterized by a bifacially flaked bit with a roughly diamond-shaped cross section. The handle may be worked to a form perpendicular to the axis of rotation, but often it is simply the unworked remainder of the flake. Four drills, suitable for hafting were identified within the lithic tool collection; three are largely complete, and one is a blade fragment. In general, these are atypical specimens as they do not exhibit the narrow, bit cross section usually associated with these tools. They do, however, display use wear patterns generally associated with drills.

Two of these tools were recovered from the 80 to 100 cm level in grid F17. The first example exhibits shallow basal notching and a short, wide stem generally reminiscent of Parowan Basal-notched arrow point hafting elements (Fig. 7.3A). The extreme tip is missing and the upper blade portion is somewhat asymmetrical. The entire tool has been bifacially worked and thinned, displaying retouch along the laterals. The generally convergent laterals exhibit unifacial use scarring on opposite surfaces, particularly near the tip. This drill was composed of type C6 chert and it measures 3.29 cm long, incomplete length, by 1.21 cm wide, at the base, and .04 to .35 cm thick. The second drill from this provenience is composed of type C1 chert. It is a corner-notched, tanged and stemmed tool, lacking the extreme tip (Fig. 7.3B). It has been completely bifacially worked and thinned, exhibiting slightly concave, but convergent, laterals. The laterals display unifacial use scarring and some crushing on opposite surfaces, particularly near the tip. It measures 2.74 cm long, incomplete length, by 1.54 cm wide, at the shoulders, and it ranges from .05 to .31 cm thick.

The third drill is represented by the tool blade, which exhibits a snap fracture along the base (Fig. 7.3C). It has been finely bifacially worked and thinned, displaying retouch along the convergent laterals. The tip is acute and the laterals exhibit extensive unifacial use scarring, along with some bifacial wear. This fragment measures 2.42 cm long, incomplete length, by 1.35 cm wide, along the broken shoulder area, and it ranges from .04 to .35 cm thick. It was recovered from a depth of 80 to 100 cm in grid E-17, and it is composed of type C1 chert.

The final specimen is a complete haftable drill which has been finely bifacially worked, thinned and retouched (Fig. 7.3D). It exhibits side notches and an expanded basal stem, as wide as the shoulders. It has an acute tip and the laterals exhibit unifacial use scarring and some crushing on opposite surfaces. It is composed of type C2 chert, and it was found in A-17, in the 60 to 80 cm level.

Scrapers

A scraper is defined as a flake that has had one or more edges modified by unifacial or bifacial pressure retouch, so as to achieve a steep edge angle. Either use retouch and/or polish may be present along the edge.

Twelve modified scrapers were identified within the lithic collection. The first is composed of type C1 chert and it was recovered from a depth of 80 to 100 cm in grid E-14. It has been bifacially thinned and retouched, most heavily on the dorsal surface. It exhibits primarily unifacial use scarring along the laterals, although one also displays limited bifacial use wear. It measures 3.21 cm by 3.37 cm and it was 1.94 cm thick.

The second scraper is made up of a piece of angular, type C1 chert, core shatter which appears to have been heat treated. It has been unifacially flaked along the steep, utilized edges. Both edges exhibit unifacial use wear, and one displays some crushing. It was recovered from the 80 to 100 cm level within Grid F-17. It measures 3.47 cm by 4.38 cm and it is a maximum of 3.08 cm thick. The third modified scraper is made up of an angular secondary flake of type C1 chert. It exhibits some limited unifacial retouch along the utilized edge. This tool measures 1.88 cm long by 2.54 cm wide and .99 cm thick. It

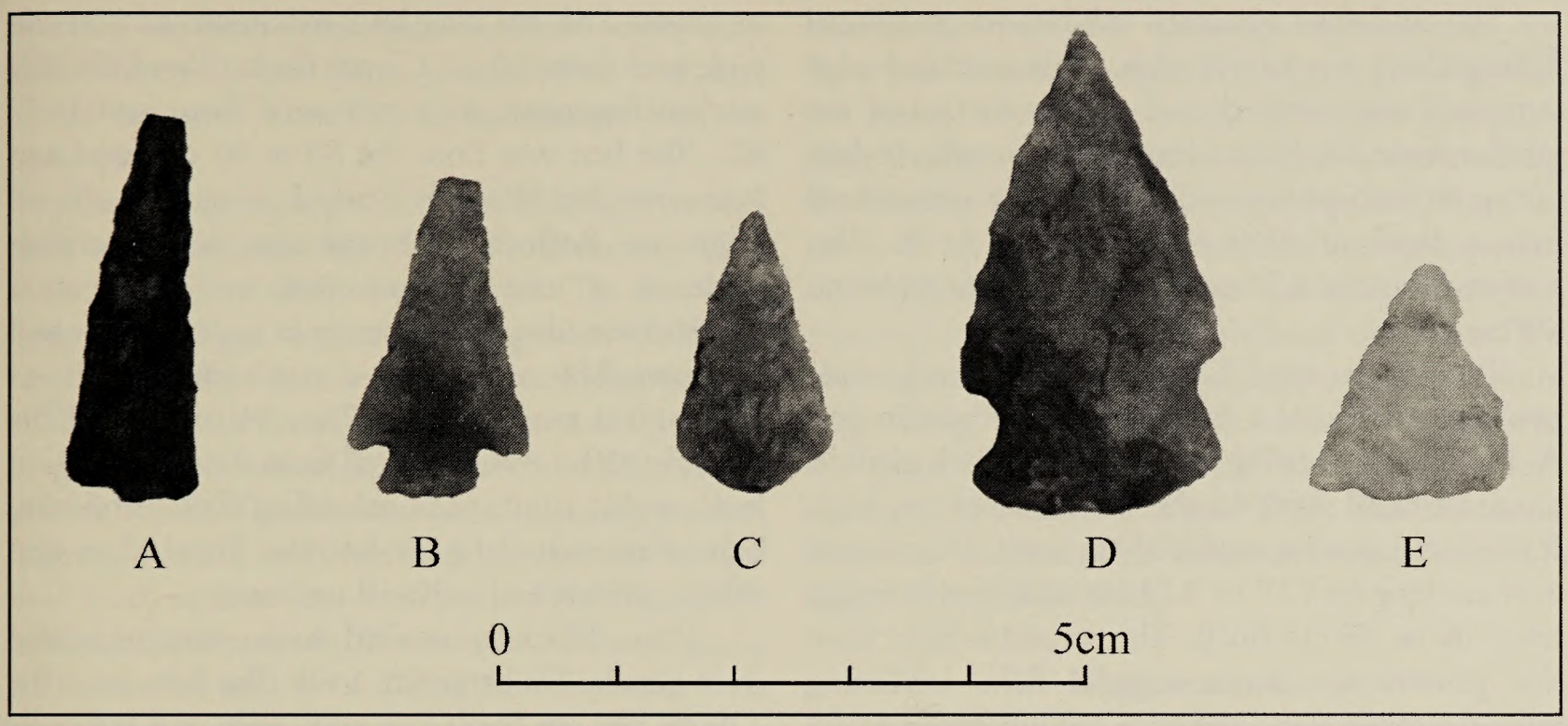


Figure 7.3. Drills. A-D, hafted drills; E, bifacially modified tool.

has been minimally used and it was recovered from Pit Structure 1 fill, at a depth of 160 to 180 cm.

The remaining nine scrapers are also composed of type C1 chert, and they all exhibit unifacial retouch along the steep, utilized edges. They include two secondary flakes, two pieces of angular core shatter, and the remaining five are broken, unidentifiable interior core flakes. These tools exhibit unifacial use wear on both modified and unmodified use edges, and they were recovered from a variety of fill situations. These included one each from 60 to 80 cm in grid A-17, 90 to 110 cm in Stratum 2 at CC-19 and CC-20, 155 to 165 cm and 165 to 185 cm in Pit Structure 2 fill, and one from 85 to 105 cm in grid A-18. The remaining four retouched scrapers were recovered, one each, from 120 to 140 cm and 160 to 180 cm levels in Pit Structure 1 fill, 80 to 100 cm in grid E-17 and from 230 to 250 cm in Pit Structure 2 fill.

Bifacially Modified Tools

Eighteen bifacially modified artifacts and two tools were identified within the collection. The first of these two latter tools is composed of type C1 chert and it was recovered from a depth of 120 to 140 cm in Pit Structure 1 fill. It looks like an unfinished, small Parowan Basal-notched arrow point which broke along one lateral, near the tip, while it was being worked on (Fig. 7.3E). It is generally triangular, exhibiting one small basal notch, and it has been completely bifacially retouched and thinned. This tool exhibits unifacial use scarring along both laterals, particularly adjacent to the tip. It measures 2.06 cm long by 1.18 cm wide, at the base, and it varies from .06 to .37 cm thick.

The second specimen is a tapered, bifacially worked, three-sided tool composed of type C6 chert. The lateral edges and both ends exhibit extensive evidence of edge grinding, and the ends are also extremely blunted. It measures 7.14 cm long by an average of 1.47 cm in diameter, and it was recovered from Pit Structure 2 (F2 midden) in CC-19. This tool is almost identical to a pair recovered from 42Ws122, a site in Zion National Park (Schroeder 1955:133; Frank 1997). It exact function is not known, but it must have included use on softer materials.

The remaining eighteen artifacts are generally composed of fragments and modified flakes, and the majority of them exhibit some form of use wear. All but two of these artifacts are composed of type C1 chert. One is made of type C2 chert and the other is composed of sandstone. The type C2 chert artifact was recovered from a depth of 110 to 130 cm in Pit Structure 2 (F2) at grid BB-19. It is a broken, unidentifiable flake which exhibits minimal bifacial retouch along the laterals and more complete work on the dorsal surface. The laterals exhibit some limited unifacial use wear, and it measures 1.71 cm long, incomplete length, by 1.7 cm wide and it ranges from .06 to .44 cm thick.

The sandstone specimen exhibits rough bifacial flaking along one lateral edge. This modified edge is tapered and abraded, and neither surface of the tabular stone has been completely ground. It does not appear to have been utilized, and it was recovered from a depth of 40 to 65 cm in grid A-18. This artifact measures 4.55 cm long by 3.12 cm wide and .74 cm thick.

The sixteen type C1 chert specimens include two recovered from a depth of 50 to 60 cm in grid A-17. One is a scallop-shaped flake which exhibits limited bifacial work on the wide, convex use edge. It displays extensive unifacial use wear. It measures 3.54 cm long by 1.19 to 3.14 cm wide and it ranges from .08 to .86 cm thick. The second artifact from this provenience is an angular flake exhibiting bifacial retouch along one edge and unifacial retouch along another edge. Both modified edges display evidence of unifacial use wear, and one exhibits some edge grinding. A natural projection at one end of the flake displays some limited unifacial work, and it was then utilized as a small graver. It measures 3.84 cm long by 1.21 cm wide and from .13 to .91 cm thick, and it is a well-used tool. A third tool was recovered from a depth of 60 to 80 cm in A-17. It is a flake exhibiting bifacial retouch along one steep and one acute edge. The steep edge displays limited evidence of unifacial use wear and the acute edge exhibits bifacial use scarring. It measures 2.11 cm by 2.81 cm and it ranges from .12 to .68 cm thick.

The next two bifacially modified artifacts were recovered from the 80 to 100 cm level in grid E-17. The first is a flake fragment which displays extensive retouch on one surface and a minimal amount on the opposing surface, particularly along the utilized, steep edge. This latter edge exhibits limited evidence of unifacial use wear. This tool measures 1.89 cm long by 1.4 cm wide and from .05 to .33 cm thick. The second artifact from this provenience is a heat-treated secondary flake exhibiting limited bifacial modification. It displays unifacial use wear along an acute, irregular, modified edge. It measures 4.45 cm long by a maximum of 2.64 cm wide, and it ranges from .17 to 1.03 cm thick.

The sixth specimen was recovered from the 80 to 100 cm level in grid F17, and it is a bifacially worked and retouched flake fragment. Part of the dorsal surface has spalled off, but there is evidence of unifacial use wear along one edge. This fragment measures 2.58 cm long by a maximum of 1.91 cm wide and from .65 to 1.2 cm thick. Two bifacially worked fragments were recovered from grid B-17 fill. The first was from the 50 to 60 cm level and it is a roughly bifacially worked, irregularly shaped fragment. Both the acute and steep laterals exhibit evidence of unifacial use wear, and one corner protuberance displays some use as a graver. This tool measures 2.86 cm long by a maximum of 2.73 cm wide and it ranges from .12 to .94 cm thick. The second artifact was recovered from the 80 to 100 cm level, and it is a broken secondary flake exhibiting bifacial retouch along the laterals. These edges also exhibit evidence of unifacial use wear.

Three bifacially worked tools were recovered from general Pit Structure 1 fill. The first, from the 120 to 140 cm level, is a unifacially and bifacially retouched, broken secondary flake which has been minimally worked. It displays evidence of unifacial use wear along the intact laterals and the broken edge. It measures 2.14 cm long by 3.6 cm wide and from .12 to .57 cm thick. The second tool from Pit Structure 1 was recovered from the 140 to 160 cm level. It is a larger, broken interior flake measuring 3.78 cm long by 1.74 cm wide and from .07 to .58 cm thick. The laterals have been unifacially and bifacially retouched, and they also exhibit extensive unifacial use wear, as well as some limited edge grinding. The third specimen from this provenience displays evidence of limited bifacial modification and some unifacial retouch along two of the edges. In addition, these modified edges exhibit evidence of unifacial and bifacial use wear. It is a broken flake fragment and it was recovered from the 160 to 180 cm level within Pit Structure 1.

The twelfth tool of this type was recovered from F4 fill and spoil, and it is a roughly bifacially modified secondary flake. It exhibits unifacial use wear on both steep and acute edges, and it measures 4.27 cm long by 2.29 cm wide and from .15 to .61 cm thick. The next artifact is a roughly bifacially modified flake fragment which displays a limited amount of unifacial use wear along the steep edges. It measures 2.5 cm long by 1 to 2.07 cm wide and from .03 to .88 cm thick. This tool was recovered from the 160 to 180 cm level in Pit Structure 3. The fourteenth tool is a modified flake fragment displaying extensive unifacial and bifacial retouch along the laterals, but only limited evidence of

unifacial use wear. It measures 3.28 cm long by 1.55 to 1.83 cm wide and from .11 to .34 cm thick, and it was recovered from F35 in association with the lower pit.

The remaining type C1 chert bifacially worked tools were both recovered from Pit Structure 4 fill, at the top of its definition at 110 cm. The first is an irregularly shaped interior flake fragment, which has been unifacially retouched on the ventral surface. It exhibits no evidence of use and it measures 4.03 cm long by a maximum of 2.3 cm wide and from .10 to .53 cm thick. The final tool is a bifacially worked fragment, which may once have been part of a larger tool. Both surfaces have been worked and the laterals exhibit bifacial retouch. It measures 2.11 cm long by 2.67 cm wide and from .08 to .88 cm thick. One steep edge displays evidence of unifacial use wear.

Unifacially Retouched

These tools are generally composed of interior core flakes that exhibit unifacial pressure flaking along one or more edges. In many instances these flakes and the modified edges have been utilized. Nine unifacially modified artifacts were recovered from 42Ka3976, and all are composed of type C1 chert.

Four of these tools are secondary, interior core, flakes, exhibiting unifacial use scarring on both unifacially modified and unmodified edges. One displays minimal modification on a natural projection, and it was recovered from a depth of 110 to 130 cm in Pit Structure 2 (F2) within grid BB-19. The next exhibits extensive unifacial use wear along the modified edge, and it was recovered from the 65 to 85 cm level in A-18. The next example displays unifacial use wear along both modified and unmodified steep and acute edges. This tool was recovered from a depth of 120 to 140 cm in Pit Structure 1. The final modified secondary flake appears to have been heat treated. It displays limited unifacial retouch on the dorsal surface, and both unifacial and bifacial use wear. It was recovered from the 160 to 180 cm level in Pit Structure 3.

One tertiary flake exhibits unifacial use scarring along both unifacially modified and unmodified edges. It was recovered from Pit Structure 1 fill at a depth of 180 to 200 cm. Two pieces of core shatter also exhibit some unifacial retouch. One, recovered from the clean-up around the Pit Structure 3 bench, exhibits minimal modification, but heavy bifacial use wear. The second angular piece exhibits retouch and unifacial use wear along the laterals. It was recovered at a depth of 80 to 100 cm in E-17. The final two artifacts are composed of unidentifiable, broken interior flakes. One exhibits minimal modification and unifacial use wear. The other specimen displays modification along an acute edge, along with subsequent unifacial and bifacial use wear. This latter example was recovered from the 80 to 100 cm level in grid F-17. The previously discussed unidentifiable flake tool was from A-18, in the 65 to 85 cm level.

Hammerstones

Hammerstones are usually small, hand-held cobbles that exhibit varying degrees of battering on natural prominences. The use areas are typically circular or oval in form, which distinguishes these artifacts from similar pounding tools. This type of wear indicates that these tools were used for pounding and crushing hard materials. They were probably used for knapping and flake production, or for the crushing of pigments, ceramic temper, or minerals.

Three hammerstones were identified within the lithic tool collection. The first hammerstone is an ovoid, palm-size, quartzite cobble. One rounded lateral exhibits evidence of use. This tool measures 6.52 cm by 5.79 in diameter, and it is 4.44 cm thick. It was recovered from a depth of 190 to 210 cm in Pit Structure 2 fill.

The remaining two hammerstones are both composed of coarse, poorly silicified type C1 chert. The first specimen is a hand tool which may have been minimally utilized as a uni-directional core. One end has been heavily pounded, so that it is now rounded. It was recovered from the 220 to 240 cm level within Pit Structure 1 fill. This tool measures 5.76 cm long by 4.2 cm in diameter. The second hammerstone was recovered from general Pit Structure 4 fill. It appears to have been tested for use as a core, but abandoned due to the coarse nature of the material. It displays evidence of use on one rounded end. It measures 8.36 cm long by 7.89 cm wide and a maximum of 5.16 cm thick.

Edge Pounders

These artifacts are similar to hammerstones in that they are small cobbles or fragments that exhibit battering along a rounded edge of either natural or manufactured origin. The generally narrower striking surfaces, however, seem to indicate that these tools were used to obtain a more concentrated point of impact than could be obtained by using the more spherical hammerstone, although they were probably used for similar purposes.

Four edge pounders, all composed of chert varieties, were found at the Arroyo site. The first is a hand-sized cobble displaying use on a few broken edges. The tool measures 6.14 cm by 6 cm in diameter, and it was recovered from a depth of 210 to 230 cm in Pit Structure 2. It is composed of type C7 chert. The next specimen is a minimally used, uni-directional core remnant, composed of type C1 chert. It displays a limited amount of use on a few edges. This tool measures 6.72 cm by 5.69 cm in diameter, and it was recovered from the 230 to 250 cm level within Pit Structure 2 fill.

The third specimen is a palm-size tool, which may have seen limited use as a uni-directional core. It is composed of type C2 chert, and it measures 6.96 cm long by 5.16 cm wide and 3.15 cm thick. It appears to have been used as both an edge pounder and a hammerstone. It was recovered from Pit Structure 1 fill, at a depth of 220 to 240 cm. The final tool is a piece of poorly silicified type C1 chert, measuring 7.83 cm long by 6.67 cm wide and an average of 5.74 cm thick. It exhibits use as an edge pounder on one end, and as an edge grinder on the other. It was recovered from Pit Structure 4 fill, in upper A-17 and B-17, at a depth of 100 to 120 cm. It is a fairly well-used tool.

Core, Cobble, and Flake Scrapers

Cobble and core scrapers are fairly large, hand-held artifacts which were used as crude scrapers. Some of these artifacts exhibit rough, hard-hammer flaking, both unifacial and bifacial, used to form the working edge, while others simply reflect use of a fortuitous edge. The flake scrapers are generally unmodified flakes that have been used as scrapers without any distinguishable modification.

Cobble Scrapers

Six cobble scrapers were identified and they are all composed of quartzite. The first is a cobble fragment exhibiting evidence of use along an acute edge. It measures 4.74 cm long by 7.52 cm wide and 3.31 cm thick. This tool was recovered from a depth of 180 to 200 cm in Pit Structure 1 fill. The next specimen is a hand-size tool, which has had one flake removed to form the acute working edge. It was recovered from the 90 to 110 cm level in F2 at CC-19 and CC-20. It measures 5.19 cm by 7.45 cm and 6.25 cm thick. The third tool is made up of a cobble end fragment, exhibiting unifacial use scarring along the single utilized edge. It measures 8.05 cm by 6.34 cm and 4.34 cm thick. It was recovered from Pit Structure 2 fill, within the 230 to 250 cm level.

The fourth cobble scraper is a palm-size cobble fragment, measuring 7.11 cm long by 4.25 cm wide and it was recovered from Pit Structure 4 fill, at the top of the definition at 110 cm. The next example was recovered from 10 to 30 cm above the floor in Pit Structure 1. It is made of a cobble fragment and it displays minimal use. It measures 6.12 cm long by 4.88 cm wide and a maximum of 3.85 cm thick. The final cobble scraper is a hand-size tool which exhibits hard-hammer flaking to form an acute use edge. It measures 7.8 cm long by 10.6 cm wide and a maximum of 4.35 cm thick. It displays minimal use and it was recovered from the second floor in Storage Room 1.

Core Scrapers

Eight core and core remnant scrapers were recovered from fill contexts at this site, and they are all composed of type C1 chert. All but one are core remnants, and the remaining tool is a bi-directional, hand-size core exhibiting use along four steep edges, as well as some evidence of edge pounding. It measures 7.22 cm by 7.23 cm in diameter, and it was recovered at a depth of 100 to 120 cm in the upper portions of grid A-17 and B-17, in Pit Structure 4 fill.

The remaining seven tools are smaller core remnants, which were recovered from a variety of stratigraphic fill situations (Provenience Tables). One exhibits minimal unifacial retouch along one steep edge, which also exhibits unifacial use scarring. The remainder exhibit use scarring on unmodified

steep edges, and one is a palm-size tool which also displays evidence of use along an acute edge.

Flake Scrapers

Fourteen tools identified as flake scrapers were recovered from this site. Twelve are quartzite and two are type C1 chert. Both of the type C1 chert examples are primary flakes, and one exhibits rough unifacial flaking along the steep utilized edge. It was recovered from a depth of 140 to 160 cm in Pit Structure 1 fill. The second chert tool is a palm-size flake exhibiting rough unifacial use scarring, and it was recovered from the 65 to 85 cm level in A-18.

The quartzite examples include four primary flakes, four secondary flakes, and four flake fragments. These tools exhibit use along both steep and acute edges, and none display any evidence of modifying flaking. In general, they exhibit evidence of unifacial use scarring, along with some minimal edge grinding and rounding. These tools were all recovered from fill contexts (Provenience Tables).

Utilized Flakes

Utilized flakes are flakes which have been struck from cores and were either not suitable for further manufacturing purposes, or were struck for incidental usage. These flakes exhibit use retouch along one or more edges, which implies that they were used for cutting hard materials such as bone or wood.

A total of 429 utilized flakes were identified from 42Ka3976 (Provenience Tables). The majority of these, 369 or 86% of the total, were composed of type C1 chert. In decreasing order of frequency 20 (6%) are composed of quartzite, 16 (5%) are type C2 chert, 10 (2%) are type C6 chert, 7 (2%) are type C4 chert, 6 (1%) are type C3 chert, and one is made up of type C7 chert. In addition, most of these tools were secondary flakes, 221 (52%), followed by unidentifiable, broken interior core flakes, 106 (25%). Tertiary flakes make up 13% of the total followed by core shatter, 7%, and lastly primary refuse, 3%.

Most of the utilized flakes exhibit varying degrees of unifacial use scarring, 278 (65%), followed by 84 (20%) specimens which were used as gravers. These small gravers exhibit varying degrees of use along natural flake projections. Some of these tools also display unifacial use wear along additional flake edges, and a few exhibit bifacially used edges. Forty-three specimens, 10%, appear to have been used as small unmodified scrapers, exhibiting unifacial use scarring along steep flake edges. Six of the scrapers also display use as gravers along unassociated flake edges.

A small number of flakes, 22 (5%), exhibit varying degrees of bifacial use wear, many with associated unifacial use scarring. The remaining two flakes exhibit edge grinding, and both are composed of quartzite.

Cores

Cores are defined as the remains of pieces of suitable stone from which flakes were struck. In general, cores within the Virgin Anasazi are not transported far from their geologic sources (Walling et al. 1986; Walling and Thompson 1986; Dalley and McFadden 1988).

Six cores were identified within the lithic collection. Three are composed of local type C1 chert, and one each is type C5 chert, type C2 chert and quartzite. This latter example is a remnant which was recovered from a depth of 80 to 100 cm in grid E-17. The type C2 chert core remnant exhibits multi-directional use and it was recovered from F35 in association with the lower pit. The type C5 chert core remnant was also used in a multi-directional manner. It was from the 60 to 80 cm level in A-17.

The type C1 chert examples include one which is composed of poorly silicified material. It appears to have been tested and then discarded. It was recovered from Pit Structure 1 fill at a depth of 10 to 30 cm above the floor. The next example included some poor quality material, and thus it was minimally used in a uni-directional manner. It was recovered from the 160 to 180 cm level in Pit Structure 1 fill. The final core remnant is a uni-directional example which was recovered from a depth of 240 to 260 cm in Pit Structure 1.

Debitage

In general, waste materials dominate lithic collections from Virgin Anasazi sites, as is the case here. The debris from the Arroyo site includes tertiary flakes, secondary and primary core flakes, core shatter, and unidentified flakes. The three former categories of debitage include those flakes

with identifiable striking platforms, while the latter two categories lack these distinctive features.

Primary core flakes are those that are removed during initial core reduction and preparation activities, and exhibit cortex on the dorsal surface. The striking platforms are unfaceted, and occasionally the dorsal surfaces are partially faceted from prior flake removal and/or core preparation. Secondary flakes are those that are removed from a core, or during the preparation of tools. They exhibit unfaceted platforms and they often show high platform angles. These flakes may exhibit cortex or faceted dorsal surfaces from prior flake removal and/or core preparation. Tertiary flakes are defined as those removed during the manufacture of bifacially modified artifacts. These flakes exhibit faceted striking platforms with an acute angle on the dorsal surface. The platform may also exhibit a lip on the ventral side, and edge grinding, developed during the preparation for flake removal, along the platform edge. The dorsal surface of these flakes is also faceted from prior flake removal. Core shatter are those angular pieces of stone which are removed during core reduction. Unidentifiable, broken flakes are pieces of debitage that are lacking any identifiable platform. The majority of these flakes are interior flakes exhibiting faceted dorsal surfaces from prior flake removal.

A total of 1395 pieces of flaking refuse were identified within the collection. This debitage was made up of nine varieties of chert, as described in Table 7.1, quartzite, and one piece of limestone. Type C1 chert is a locally available material found in the Chinle Formation, along the Vermilion Cliffs. Type C2 chert also appears to be a locally available material, although its source is not known; its resemblance to type C1 may suggest that it also comes from the Chinle Formation. Quartzite would have been found in the local alluvial valley fills, and it appears to have been a heavily utilized material, although much of the refuse was probably produced during the flaking modifications performed on the cobble lithic and ground stone hand tools. The remaining varieties, types C3 through C9, appear to have been imported into the site area, as they make up only 6% of the remaining debitage (Table 7.2). The majority of the debitage, 45%, is made up of secondary flakes, while 22% is composed of tertiary flakes, 19% are unidentifiable, broken, core flakes, 10% of the debris is core shatter, while primary flakes make up only 4% of the collection.

Cortex was present on 27% of the total debitage collection, and it was found on all of the utilized material except type C8 chert and the limestone flake (Table 7.3). Quartzite, the most readily available material, exhibited cortex on 61% of the collected flakes, while only 10% of the type C1 chert specimens exhibited cortex.

SUMMARY

A total of 583 modified and unmodified tools were identified within the collection. Typical for Virgin Anasazi lithic assemblages of this period is the dominance of utilized flakes within the overall tool category, with 429 identified specimens making up 74% of the collection. These are simple expedient tools which can be produced quickly, and serve a variety of cutting and scraping functions. In addition, the utilized flakes are primarily composed of locally available types C1 and C2 cherts.

In terms of overall material composition, the majority of the debitage, as well as the modified and unmodified lithic tools, are composed of locally available type C1 chert, making up 73%, 69% and 86% of the collections, respectively. Its general availability and overall quality makes it an obvious choice. In addition, there is evidence that this material was also heat-treated to some degree, including the appearance of angular crazing patterns and a dulling of the stone. This was primarily noted on a limited amount of refuse and a few utilized flakes.

The two primary diagnostic arrow point types recovered from this site, the Parowan Basal-notched and the Bull Creek types, are both representative of the Pueblo II period in the Virgin Anasazi region. Parowan Basal notched points are the principal type found in Virgin Anasazi sites in Washington County, to the west, as well as Fremont sites to the north and northwest. Bull Creek points generally appear later in the Virgin Anasazi region, post A.D. 1050 and possibly not until as late as A.D. 1150. They are more frequently found in Virgin sites located east and northeast of Washington County, and in significantly lower frequencies in the extreme southwestern part of Utah. Bull Creek points are

Material Type	Totals	Primary Flakes	Secondary Flakes	Tertiary Flakes	Core Shatter	U/id Flakes
C1	1019 (73)*	32 (3.1)	405 (40)	262 (26)	112 (11)	208 (20)
Quartzite	221 (16)	8 (3.5)	159 (72)	8 (3.5)	11 (5)	35 (16)
C2	75 (5)	2 (3)	38 (51)	12 (16)	7 (9)	16 (21)
C3	25 (2)	1 (4)	9 (36)	9 (36)	3 (12)	3 (12)
C4	21 (1)		8 (38)	8 (38)	1 (5)	4 (19)
C5	16 (1)	1 (6)	5 (31)	8 (50)		2 (13)
C6	12 (.8)	1 (8.5)	6 (50)	4 (33)		1 (8.5)
C7	4 (.3)		3 (75)			1 (25)
C8	1 (.45)		1 (100)			
Limestone	1 (.45)					1 (100)

*(73) - Percentage of the total number of flakes in the Totals column, and percentage by material type in flake columns.

Table 7.2. Debitage material type summary

Material Type	C1	Quartzite	C2	C3	C4	C5	C6	C7	C8	Limestone
Total	1019	221	75	25	21	16	12	4	1	1
Cortex Present	10%	61%	13%	19%	24%	8.3%	9.5%	25%	0	0

Table 7.3. Percentage of cortex present on debitage by material type.

also typical of late Pueblo II to early Pueblo III sites in the Kayenta Anasazi region in northern and northeastern Arizona. This may, in part, explain their later appearance in the Virgin Anasazi area.

The single recovered Rose Spring arrow point is not temporally related to the late Pueblo II to early Pueblo III occupation of this site, and neither is the late Archaic Pinto-type point. These points may represent either prehistorically curated specimens, or artifacts left in the site area by people passing through the area.

In terms of modified tools, knives and knife fragments are the most prevalent type within the collection, making up 32% of the modified specimens, followed by bifacially modified tools, 14%, and scrapers, 11%. The knives primarily exhibit unifacial use wear along the blade laterals, 23 of the 32 artifacts; six exhibit both unifacial and bifacial use wear, including both of the haftable knives; two display evidence of unifacial use wear and edge grinding; and only one displays just edge grinding. The majority of the tools appear to have been used on resistant materials.

Overall, the debitage is primarily composed of debris consistent with tool production and maintenance activities, with a more limited amount associated with core reduction. The majority of the cores and reduction refuse is composed of type C1 chert, suggesting that imported materials were transported and/or traded to the site sporadically, and then as reduced cores or as finished tools. As the source for type C1 chert is generally within the local Chinle Formation, it is not surprising that it is the most heavily utilized material.

There is a complete absence of obsidian in the collection, and although it usually occurs in only limited frequencies in Virgin sites, it generally appears in the form of finished tools and/or as tool production or maintenance refuse. The primary obsidian sources for this region are to the northwest

in the Mineral Mountains, Beaver County, and near Panaca, Nevada, just west of Iron County. The absence of obsidian may imply limited interaction with populations to the north and northwest.

The few recovered miscellaneous artifacts, primarily gypsum nodules and iron ore fragments, are available in the surrounding region. The latter material is found at sites to the west, particularly as it also appears to be associated with the formation of a variety of hematite. The source for this material is not known, but its appearance at locations on Little Creek Mesa and in Colorado City, in sites excavated by the Southern Utah University Archeological Field School, has documented the common occurrence of iron ore specimens during the Formative period. Exposures of gypsum are found in southern Utah, and the nodules recovered from this site may well have come from a local outcrop.

The majority of the lithic artifacts were recovered from fill situations (Provenience Tables), with heavy concentrations seen in the F2 midden area and in excavation units. This suggests some housekeeping within the structures and site area and a prolonged occupation, as does the general lack of lithic refuse found within the lowest structural fill levels and floor associations. All but one of the diagnostic arrow points were recovered from fill contexts. The exception is a Parowan Basal-notched point recovered from the fill near the floor of Pit Structure 2. The small Corner-notched, stemmed point was also recovered from within 15 cm of the floor of Residential Room 1. All of the remaining projectile points were recovered from structural fill and excavation units, from depths of 40 to 140 cm. Two of the Bull Creek points were from the F2 midden area, as was the Pinto point. In general, there does not appear to be any spatial/areal differentiation in the distribution of either the Parowan Basal-notched or Bull Creek points. The only evidence of stratigraphic distribution was in Grid A-17 where the Parowan points were found in a lower level, 80 to 100 cm, while the Bull Creek points were recovered from the 50 to 60 cm and 60 to 80 cm levels.

In general, the floors and lower fill levels of the structures contained a very limited number of lithic debris or tools, with ground stone tools being more common in these proveniences. Residential Room 1 yielded the previously mentioned arrow point, two utilized flakes, and four flakes from fill above the floor. Two knives, three utilized flakes and eight pieces of debitage were recovered in association with the floor. The lower 10 cm of fill and the floor on Pit Structure 3 also yielded ten pieces of debitage, while only ground stone tools were recovered from the bench surface. As discussed, a Parowan Basal-notched point was recovered from the lower fill of Pit Structure 2, along with two utilized flakes and a secondary flake found in association with the floor surface.

In summary, the lithic tools and debris suggest that tool production and maintenance activities were the primary lithic production activities at this site. The principal utilized materials, type C1 chert, quartzite, and type C2 chert, are all locally available, and they were also the materials primarily associated with the more limited core reduction activities conducted here. In general, the lithic materials suggest a fairly insular group, primarily relying on locally available materials for tool production. The tools themselves support a full range of domestic activities, including a representation of projectile points, suggesting that hunting was a primary activity at this site, which is supported, in part, by the faunal collection. In general, the representative arrow points, both the Parowan Basal-notched and Bull Creek types, support a late Pueblo II occupation of the site area, while the Bull Creek points may support an even later use, during the later Pueblo II to early Pueblo III period. Bull Creek points also point to some type of contact with the Kayenta tradition, where they appear to have originated before spreading into the Virgin area.

Pit Structure 1

Pit Structure 1 Spoil
1 Mano fragment, unifacial, modified, leading-following, SS
1 Mano fragment, unifacial, modified, SS
1 Polishing stone fragment, Q
2 Cobble scrapers, Q
1 Ground stone fragment, Q
2 Ground stone fragments, SS

1 Hafted knife, C1

Pit Structure 1 Spoil in front of and near floor level
1 Knife mid-section fragment, C1
1 Utilized flake, C1

1 Core shatter, C1
1 Secondary flake, Q

Pit Structure 1 Spoil near floor
Northern side wall, Fill above Pit Structure 1 100 cm below surface
1 Mano fragment, unifacial, modified, leading-following, SS

Pit Structure 1 Fill
1 Abrading stone, unifacial, modified, cylindrical, SS
1 Modified stone fragment, SS
3 Cobble scrapers, Q
4 Ground stone fragments, SS
1 Iron ore fragment with jasper interior

5 Utilized flakes, C1
1 Utilized flake, Q

7 Secondary flakes, C1- 1 w/cortex
1 Core shatter, C1
2 U/id flakes, C1
1 Secondary flake, C2
1 Secondary flake, C7
11 Secondary flakes, Q- 4 w/cortex
2 U/id flakes, Q- 1 w/cortex

Pit Structure 1 Fill 120-140 cm
1 Mano fragment, unifacial, modified, leading-following, SS
1 Mano fragment, unifacial, modified, SS
1 Abrading stone, unifacial, modified, Q
1 Mano, complete, one-hand, bifacial, modified, leading-following laterals, SS
1 Disk, SS
1 Cobble abrader, Q

2 Secondary flakes, C1
1 Tertiary flake, C1

Grid 16, Fill above Pit Structure 1
1 Trough metate fragment, SS
1 Modified ground stone fragment, SS
1 Iron ore fragment

Grid 16, Fill above Pit Structure 1 100-120 cm
1 Cobble abrader, C5

5 Utilized flakes, C1

Grid 17, Fill above Pit Structure 1
1 Knife, C1

3 Secondary flakes, C1- 1 w/cortex
Pit Structure 1 Fill, Grid F16 100-120 cm
1 Ground stone fragment, SS

1 Knife, C3
9 Utilized flakes, C1

3 Secondary flakes, C1
1 U/id flake, C1
2 Secondary flakes, Q
1 Core shatter, Q

Pit Structure 1 Fill, E-18 120-140 cm
1 Flake abrader, Q
8 Ground stone fragments, SS

8 Utilized flakes, C1

1 Primary flake, C1
2 Secondary flakes, C1- 1 w/cortex
2 Tertiary flakes, C1
3 Core shatter, C1
1 U/id flake, C1

1 Abrading stone, unifacial, modified, B
1 Abrading stone, unifacial, unmodified, SS
1 Disk, SS
1 Sphere, Q
1 Cobble abrader, Q

1	Flake abrader, Q
1	Ground stone fragment, SS
1	Bull Creek arrow point, C1
1	Knife mid-section fragment, C1
1	Bifacially modified, C1
1	Unifacially modified, C1
1	Scraper, C1
1	Bifacially worked tool, C1
16	Utilized flakes, C1
1	Utilized flake, C2
1	Utilized flake, C6
2	Primary flakes, C1
14	Secondary flakes, C1- 4 w/cortex
14	Tertiary flakes, C1
3	Core shatter, C1
6	U/id flakes, C1
1	Secondary flake, C2
1	Tertiary flake, C2
1	U/id flake, C2
1	Secondary flake, C3
1	Tertiary flake, C5
1	U/id flake, C5
1	U/id flake, C6 w/cortex
1	Primary flake, Q
2	Secondary flakes, Q w/cortex
1	U/id flake, Q w/cortex

Pit Structure 1 Fill 140-160 cm

1	Abrading stone fragment, unifacial, unmodified, Q
1	Disk, SS
1	Sphere, SS
1	Flake abrader, Q
2	Ground stone fragments, SS
1	Bifacially modified, C1
1	Flake scraper, C1
1	Utilized flake, C1
2	Primary flakes, C1
8	Secondary flakes, C1- 1 w/cortex
2	Tertiary flakes, C1
1	U/id flake, C1
1	Secondary flake, C2
1	Secondary flake, C6
1	Primary flake, Q
1	Secondary flake, Q w/cortex

Pit Structure 1 Fill 160-180 cm

1	Mano fragment, unifacial, modified, leading-following, SS
3	Cobble abraders, Q
1	Flake abrader, Q
4	Ground stone fragments, SS
1	Tapered concretion, SS
1	Cylindrical piece, SS
1	Eccentric, C2
1	Scraper, C1
1	Scraper, C2
1	Bifacially modified, C1
1	Core, C1
6	Utilized flakes, C1
7	Secondary flakes, C1- 1 w/cortex, 1 heat treated
5	Tertiary flakes, C1
1	Core shatter, C1
1	Secondary flake, C4
1	Secondary flake, C6
1	U/id flake, C6
1	Secondary flake, Q

Pit Structure 1 Fill 180-200 cm

1	Abrading stone fragment, unifacial, modified, SS
1	Flake abrader, Q
4	Ground stone fragments, SS
1	Knife, C1
1	Unifacially modified, C1
1	Core scraper, C1
1	Cobble scraper, Q
5	Utilized flakes, C1
1	Primary flake, C1
5	Secondary flakes, C1
3	Core shatter, C1
1	U/id flake, C1
2	Secondary flakes, C2
1	Secondary flake, Q

Pit Structure 1 Fill 200-220 cm

1	Mano fragment, bifacial, modified, leading-following, SS
1	Abrading stone, unifacial, unmodified, SS
1	Abrading stone, bifacial, modified, Q
1	Abrading stone fragment, unifacial,

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

	modified, Q
3	Cobble abraders, Q
3	Flake abraders, Q
1	Flake abrader, C1
1	Ground stone fragment, SS
2	Gypsum nodules
2	Utilized flakes, C1
1	Primary flake, C1
5	Secondary flakes, C1- 1 w/cortex
7	Tertiary flakes, C1
3	Core shatter, C1
2	U/id flakes, C1
1	Secondary flake, C3
1	U/id flake, C6
6	Secondary flakes, Q- 4 w/cortex
1	Tertiary flake, Q
1	U/id flake, Q

Pit Structure 1 Fill 220-240 cm

1	Mano fragment, unifacial, modified, leading-following, SS
1	Abrading stone, unifacial, unmodified, SS
1	Disk, SS
1	Edge grinder, Q
2	Cobble abraders, Q
1	Ground stone fragment, SS
6	Iron ore fragments
1	Hammerstone, C1
1	Edge pounder, C2
3	Utilized flakes, C1
1	Utilized flake, C4
2	Secondary flakes, C1
1	Tertiary flake, C2

Pit Structure 1 Fill 240-260 cm

1	Basin metate fragment, SS
1	Abrading stone, unifacial, modified, Q
1	Flake abrader, Q
1	Ground stone fragment, SS
1	Core remnant, C1
2	Secondary flakes, C1
1	Core shatter, C1
1	Tertiary flake, C2
4	Secondary flakes, Q w/cortex

Pit Structure 1 Fill, West side 220 cm

1	Abrading stone fragment, unifacial, modified, Q
2	Cobble abraders, Q

Pit Structure 1 Fill, 30-50 cm above floor

2	Mano fragments, unifacial, modified, leading-following, SS
1	Mano fragment, bifacial, modified, leading-following, SS
1	Mano fragment, bifacial, modified, SS
1	Utilized flake, C1
1	Tertiary flake, C1
1	Tertiary flake, C2

Pit Structure 1 Fill, 30-10 cm above floor

2	Cobble abraders, Q
1	Cobble scraper, Q
1	Core, C1
1	Utilized flake, C1
1	Utilized flake, C4
1	Tertiary flake, C1
1	Tertiary flake, Q

Pit Structure 1 Floor contact; contact to 10 cm

1	Mano fragment, unifacial, modified, leading-following, SS
1	Mano fragment, one-hand, unifacial, modified, SS
1	Sphere, C6
4	Cobble abraders, Q
1	Core shatter, C1

Pit Structure 1 Floor contact

1	Abrading stone, unifacial, modified, SS
1	Abrading stone, bifacial, modified, SS
1	Utilized flake, C1

F4 through F9 (Storage Room 1)

F4 Fill and spoil

1	Carbonate disk

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

1 Bifacially worked tool, C1
2 Utilized flakes, C1

1 Metal sphere

Burial 1, looter's backdirt
2 Flake abraders, Q

1 Parowan Basal-notched arrow point, C1

1 Secondary flake, Q

Fill above Residential Room 1
1 Abrading stone, bifacial, unmodified, Q

Grid K-12 over Residential Room 1 60-80 cm
1 Cobble abrader, Q

Residential Room 1 Fill
1 Flake abrader, Q
2 Flake scrapers, Q

2 Utilized flakes, C1

1 Secondary flake, Q w/cortex

Fill above Residential Room 1 floor, 15 cm above floor
3 Cobble abraders, Q
1 Cobble abrader, C5
3 Flake abraders, Q

1 Corner-notched, stemmed arrow point, C5
2 Utilized flakes, C1

1 Tertiary flake, C1
1 Core shatter, C1
1 U/id flake, C1
1 Secondary flake, Q

Residential Room 1 Floor contact
1 Knife, C1
1 Knife, C5
3 Utilized flakes, C1

1 Secondary flake, C1
3 Tertiary flake, C1

Pit Structure 3

Spoil in front of Pit Structure 3
1 Hoe, SS

1 Secondary flake, C2
1 U/id flake, C2
1 Secondary flake, C4
1 Tertiary flake, Q

Residential Room 1 floor beneath Pit Structure 18 wall
1 Cobble abrader, Q

Residential Room 1 contact with lower floor
1 Secondary flake, C1
1 Tertiary flake, C1
1 U/id flake, C1

Residential Room 1 Fill above lower fill
1 Utilized flake, C2

F8 Fill
2 Utilized flakes, Q

Storage Room 1 Fill, initial clean-up upper 10-15 cm
1 Disk, SS
1 Ground stone fragment, SS

1 Knife base fragment, C9
2 Utilized flakes, C1

1 Secondary flake, C1 w/cortex
1 Tertiary flake, C1
1 U/id flake, C1

Storage Room 1 Floor contact-upper surface
1 Mano, two-hand, unifacial, modified, leading-following, SS

1 U/id flake, C1

Storage Room 1 Floor contact-lower
1 Cobble scraper, Q

1 Secondary flake, C1
1 Tertiary flake, C1

Storage Room 1 Floor contact-#2 floor
1 Cobble abrader, Q

Spoil
1 Utilized flake, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

F1, just down from Pit Structure 3		1	Ground stone fragment, SS
1	Mano, two-hand, unifacial, modified, leading-following, SS	1	Parowan Basal-notched arrow point, C1
		1	Knife tip fragment, C2
Pit Structure 3 Fill		4	Utilized flakes, C1
1	Mano fragment, unifacial, modified, leading-following, SS	1	Utilized flake, C2
		1	Utilized flake, C3
1	Ground stone fragment, SS		
		1	Primary flake, C1
1	Knife tip fragment, C5	1	Secondary flake, C1
1	Core scraper, C1	7	Tertiary flakes, C1
1	Utilized flake, C1	1	Core shatter, C1
		1	U/id flake, C1 w/cortex
1	Secondary flake, Q w/cortex	1	U/id flake, C2
		1	Secondary flake, C4
Pit Structure 3 Fill, 100-120 cm		1	Tertiary flake, C6
2	Mano fragments, unifacial, modified, leading-following, SS	2	Secondary flakes, Q w/cortex
1	Abrading stone, unifacial, modified, Q		
Pit Structure 3 Fill, 120-140 cm			
1	Cobble abrader, Q	4	Utilized flakes, C1
		1	Utilized flake, C6
1	Knife base fragment, C5		
2	Utilized flakes, C1	2	Primary flakes, C1
		6	Secondary flakes, C1- 2 w/cortex
2	Secondary flakes, C1	2	Tertiary flakes, C1
3	Tertiary flakes, C1	2	Core shatter, C1
1	U/id flake, C1 w/cortex	4	Secondary flakes, Q w/cortex
1	U/id flake, Q	1	Tertiary flake, Q
		1	U/id flake, Q
Pit Structure 3 Fill, 140-160 cm			
1	Cobble abrader, Q	Pit Structure 3 Fill, 180-200 cm	
1	Ground stone fragment, SS	1	Basin metate fragment, SS
		1	Mano fragment, unifacial, modified, SS
1	Utilized flake, C1	1	Utilized flake, C1
2	Secondary flakes, C1- 1 w/cortex	4	Secondary flakes, C1- 1 w/cortex
2	Tertiary flakes, C1	4	Tertiary flakes, C1
		3	Secondary flakes, Q- 1 w/cortex
Pit Structure 3 Fill, 160-180 cm			
2	Mano fragments, unifacial, modified, leading-following, SS	F 10 Floor contact, lower 10 cm	
		3	Secondary flakes, C1
1	Abrading stone fragment, unifacial, modified, Q	1	Tertiary flake, C1
		3	U/id flakes, C1
1	Disk fragment, SS	1	Tertiary flake, C4
1	Modified stone fragment, SS		
1	Ground stone fragment, SS	5-10 cm above F 10 floor	
		1	Secondary flake, Q
1	Arrow point fragment, C3	1	Tertiary flake, Q
1	Bifacially worked tool, C1		
1	Unifacially modified, C1	Pit Structure 3 Bench fill	

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

1 Mano fragment, bifacial, modified, leading-following, SS
1 Abrading stone, unifacial, modified, Q
1 Disk, SS

1 Tertiary flake, C6
1 Primary flake, Q
1 Secondary flake, Q

Pit Structure 3 Bench contact
1 Mano, two-hand, bifacial, modified, leading-following, SS
1 Mano, two-hand, unifaical, modified, leading-following, SS
1 Mano fragment, unifacial, modified, SS
1 Cobble abrader, Q

Pit Structure 2

Pit Structure 2 Spoil vicinity
1 Mano, one-hand, unifacial, modified, leading-following, Q
1 Mano fragment, two-hand, unifacial, modified, SS
1 Cobble abrader, Q
1 Ground stone fragment, SS

Pit Structure 2 Fill
1 Mano fragment, unifacial, modified, SS
1 Modified stone, SS

1 Biface base fragment, C5
1 Utilized flake, C1

1 Secondary flake, C1 w/cortex

Pit Structure 2 Fill 155-165 cm
1 Mano fragment, unifacial, modified, SS
1 Modified stone fragment, SS
3 Ground stone fragments, SS

1 Scraper, C1
3 Utilized flakes, C1

1 Primary flake, C1
10 Secondary flakes, C1- 1 w/cortex
1 Tertiary flake, C1
1 Core shatter, C1
5 U/id flakes, C1
1 Secondary flake, C2
1 Tertiary flake, C2
1 U/id flake, C3

1 Flake abrader, Q

Pit Structure 3 Clean-up around bench
1 Unifacially modified, C1

F29 in Pit Structure 3, on or close to surface of sand
1 Edge grinder, C1
2 Cobble abraders, Q
1 Flake abrader, Q

F29 or +/- surface of sand
1 U/id flake, C1

F29 Floor contact
1 Grinding slab fragment, SS

Pit Structure 2 Fill 165-185 cm
1 Abrading stone, unifacial, modified, Q
1 Abrading stone, bifacial, modified, Q
1 Disk, SS
1 Cobble abrader, C7
1 Flake abrader, Q

1 Scraper, C1
7 Utilized flakes, C1
1 Utilized flake, C4

1 Primary flake, C1
7 Secondary flakes, C1- 1 w/cortex
3 Tertiary flakes, C1
1 Core shatter, C1
1 Tertiary flake, C3
1 Tertiary flake, C4
2 Secondary flakes, Q w/cortex
1 U/id flake, Q

Pit Structure 2 Fill 185-210 cm
1 Basin metate fragment, B
1 Mano, two-hand, unifacial, modified, SS
1 Mano fragment, unifacial, modified, SS
1 Abrading stone, unifacial, modified, Q
1 Modified stone fragment, SS
8 Cobble abraders, Q
1 Flake abrader, Q
3 Ground stone fragments, SS

1 Biface fragment, C1
3 Utilized flakes, C1

4 Secondary flakes, C1- 2 w/cortex

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

2 Tertiary flakes, C1

Pit Structure 2 Fill 190-210 cm
1 Mano fragment, two-hand, bifacial, modified, leading-following, SS
1 Abrading stone, unifacial, modified, SS
1 Cobble abrader, B
1 Cobble abrader, Q

1 Core scraper, C1
1 Hammerstone, Q
1 Utilized flake, C1
1 Edge pounder, C7
6 Utilized flakes, C1
2 Utilized flakes, C2

1 Secondary flake, C1 w/cortex
1 Tertiary flake, C1
1 Core shatter, C1
1 Tertiary flake, C2
1 Core shatter, C2
1 Secondary flake, Q w/cortex

Pit Structure 2 Fill 230-250 cm
2 Mano fragments, unifacial, modified, SS
1 Disk, SS
1 Hatch cover fragment, SS
1 Modified stone fragment, SS
1 Polishing stone, Q
6 Cobble abraders, Q
4 Ground stone fragments, SS

1 Scraper, C1
1 Cobble scraper, Q
1 Edge pounder, C1
1 Utilized flake, C1

1 Secondary flake, C1
1 Core shatter, C1
1 Primary flake, C2
1 Core shatter, C2
2 Secondary flakes, Q w/cortex

Pit Structure 2 Fill 250-270 cm
1 Parowan Basal-notched arrow point, C1

1 Secondary flake, C1

Floor contact - contact to 10 cm
1 Core shatter, C1

4 Secondary flakes, C1
1 Tertiary flake, C1
1 Core shatter, C1
1 U/id flake, Q

Pit Structure 2 Fill 210-230 cm
1 Abrading stone, bifacial, unmodified, SS
1 Disk, SS
1 Sphere, B
6 Cobble abraders, Q

Floor contact
1 Abrading stone, unifacial, modified, Q
1 Abrading stone fragment, unifacial, modified, Q
1 Cobble abrader, Q

2 Utilized flakes, C1

1 Secondary flake, C1

F1, vicinity of Pit Structure 2
1 Parowan Basal-notched arrow point, C6

F25, vicinity of overlying Pit Structure 2 "bench"
1 Abrading stone, bifacial, modified, Q

Pit Structure 12 in Pit Structure 2, upper clay fill
1 Disk, SS

Fill in Grid BB19
1 Tertiary flake, C1
1 Secondary flake, Q w/cortex

Fill in CC-19 110-130 cm
1 Modified stone fragment, SS
1 Ground stone fragment, SS

1 Utilized flake, C1
1 Utilized flake, C6

2 Secondary flakes, C1
1 Tertiary flake, C1
1 Core shatter, C1
1 U/id flake, C1

Fill in CC-19 130-145 cm
1 Ground stone fragment, SS

1 Secondary flake, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

1	Tertiary flake, C1
1	Tertiary flake, C2
Fill in CC-19 145-155 cm	
1	Disk, SS
1	Cobble abrader, Q
1	Flake abrader, Q
1	Core scraper, C1
2	Utilized flakes, C12
2	Secondary flakes, C1- 1 w/cortex
1	Core shatter, C1
Fill in CC-19 155-165 cm	
1	Mano fragment, unifacial, modified, leading-following, SS
1	Abrading stone, unifacial, unmodified, SS
1	Abrading stone, bifacial, modified, Q
1	Sphere, SS
1	Flake abrader, Q
1	Ground stone fragment, PW
2	Ground stone fragments, SS
1	Hafted knife, C1
1	Preform, C1
5	Utilized flakes, C1
1	Secondary flake, C1
1	Tertiary flake, C1
Pit Structure 2, CC20 100-145 cm	
1	Utilized flake, C1
Grid CC20, 145-155 cm	
1	Knife tip fragment, C1
1	Biface base fragment, C1
2	Utilized flakes, C1
F2 midden at Pit Structure 2 90-100 cm	
2	Utilized flakes, C2
F2 midden at Pit Structure 2 90-110 cm	
3	Secondary flakes, C1
1	Tertiary flake, C1
3	U/id flakes, C1
1	Secondary flake, C6
1	Primary flake, Q
1	Secondary flake, Q
F2 midden at Pit Structure 2 CC20 90-110 cm	
1	Deep red pigment, SS
F2 midden at BB19	
1	Pinto dart point, C6
(F2 midden) BB19 90-110 cm	
1	Disk, SS
1	Arrow point blade fragment, C2
1	Knife mid-section fragment, C4
14	Utilized flakes, C1
1	Utilized flake, C3
1	Utilized flake, C4
2	Utilized flakes, Q
2	Primary flakes, C1
10	Secondary flakes, C1- 4 w/cortex
25	Tertiary flakes, C1
9	Core shatter, C1
38	U/id flakes, C1- 9 w/cortex
4	Secondary flakes, C2
4	U/id flakes, C2- 1 w/cortex
2	Secondary flakes, C3
1	Secondary flake, C4
3	Tertiary flakes, C4
1	U/id flake, C4
1	Secondary flake, C6
1	Tertiary flake, C6
1	U/id flake, C7
14	Secondary flakes, Q- 4 w/cortex
7	U/id flakes, Q- 4 w/cortex
(F2 midden) BB19 110-130 cm	
1	Flake abrader, Q
1	Disk, SS
4	Ground stone fragments, SS
1	Knife base fragment, C1
1	Bifacially modified, C2
1	Unifacially modified, C1
11	Utilized flakes, C1
1	Utilized flake, C3
1	Utilized flake, C7
1	Utilized flake, Q
18	Secondary flakes, C1- 1 w/cortex, 1 heat treated
11	Tertiary flakes, C1- 1 heat treated
3	Core shatter, C1
12	U/id flakes, C1- 3 w/cortex
1	Secondary flake, C2

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

2	Core shatter, C2
2	U/id flakes, C2
1	Secondary flake, C3 w/cortex
1	Tertiary flake, C3
1	Secondary flake, C4 w/cortex
2	Tertiary flakes, C4
1	Tertiary flake, C6
1	Secondary flake, C7
3	Secondary flakes, Q- 1 w/cortex
2	U/id flakes, Q- 1 w/cortex

(F2 midden) BB19 110-125 cm

1	Ground stone fragment, SS

(F2 midden) BB19 125-145 cm

1	Disk, SS
1	Flake abrader, Q
3	Ground stone fragments, SS
8	Utilized flakes, C1
7	Secondary flakes, C1- 2 w/cortex, 1 heat treated
2	Tertiary flakes, C1
1	Secondary flake, C2

(F2 midden) BB19 145-155 cm

1	Mano fragment, unifacial, modified, SS
1	Abrading stone, unifacial, modified, Q
2	Cobble abraders, Q
2	Flake abraders, Q
1	Modified stone, SS
1	Ground stone fragment, SS
1	Tertiary flake, C1
1	Core shatter, C1
1	Secondary flake, Q w/cortex

(F2 midden) CC19

1	Cobble abrader, Q
1	Flake abrader, Q
1	Ground stone fragment, SS
1	Pendant blank, SS
1	Arrow point mid-section fragment, C1
1	Knife tip fragment, C1
1	Knife base fragment, C1
1	Bifacially worked tool, C6
15	Utilized flakes, C1
2	Primary flakes, C1
18	Secondary flakes, C1- 5 w/cortex
17	Tertiary flakes, C1
16	Core shatter, C1
9	U/id flakes, C1
1	Primary flake, C2
2	Secondary flakes, C2
1	Core shatter, C2
1	Secondary flake, C5
1	Core shatter, C6
1	Secondary flake, C8
8	Secondary flakes, Q- 6 w/cortex
1	U/id flake, Q

(F2 midden) CC20 90-110 cm

1	Ground stone fragment, SS
1	Grooved piece, SS
1	Biface base fragment, C1
1	Utilized flake, C3
5	Secondary flakes, C1
5	Tertiary flakes, C1
1	Core shatter, C1
3	U/id flakes, C1
1	Secondary flake, C2
1	U/id flake, C2
1	Secondary flake, Q w/cortex

F2 at CC19 and CC20 90-110 cm

1	Abrading stone, unifacial, modified, SS
1	Ground stone fragment, SS
1	Bull Creek arrow point, C1
1	Bull Creek arrow point, C2
1	Side-notched, stemmed arrow point, C4
1	Arrow point fragment, C1
1	Knife tip fragment, C1
1	Knife base fragment, C3
1	Arrow point preform, C1
1	Preform, C6
1	Scraper, C1
1	Cobble scraper, Q
21	Utilized flakes, C1
1	Utilized flake, C3
3	Utilized flakes, Q
4	Primary flakes, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

19	Secondary flakes, C1- 1 w/cortex
30	Tertiary flakes, C1
2	Core shatter, C1
12	U/id flakes, C1- 3 w/cortex
2	Secondary flakes, C2
1	U/id flake, C2
2	Tertiary flakes, C3
1	Tertiary flake, C4
1	U/id flake, C4
1	Secondary flake, C7 w/cortex
3	Secondary flakes, Q- 2 w/cortex
<u>B17 F2 midden 60-80 cm</u>	
1	Flake abrader, Q
1	Knife mid-section fragment, C1
1	Knife tip fragment, C6
<u>F14 through F40</u>	
<u>F14 Upper fill</u>	
1	Flake scraper, Q
<u>F15 Grid 80-100 cm</u>	
1	Utilized flake, C1
1	Primary flake, C1
2	Secondary flakes, C1- 1 w/cortex, 1 heat treated
1	U/id flake, C1
2	Secondary flakes, Q w/cortex
<u>F15 Grid 100-120 cm</u>	
1	Disk, SS
1	Cobble abrader, Q
1	Utilized flake, C1
1	Secondary flake, C1- heat treated
<u>F16 80-100 cm</u>	
1	Grinding slab, SS
1	Disk, SS
1	Flake abrader, Q
1	Biface mid-section fragment, C1
7	Utilized flakes, C1
1	Utilized flake, C4
1	Utilized flake, Q
16	Secondary flakes, C1- 5 w/cortex
4	Tertiary flakes, C1
1	Knife base fragment, C1
7	Utilized flakes, C1
1	Utilized flake, C3
1	Utilized flake, C4
1	Utilized flake, C6
1	Primary flake, C1
8	Secondary flakes, C1
5	Tertiary flakes, C1
2	U/id flakes, C1
1	Secondary flake, Q w/cortex
<u>F2, Vic. of M30</u>	
1	Utilized flake, Q
1	Secondary flake, C1 w/cortex
3	Core shatter, C1
10	U/id flakes, C1
1	U/id flake, C2
1	Secondary flake, C5
1	Tertiary flake, C5
1	Primary flake, Q
4	Secondary flakes, Q- 3 w/cortex
4	U/id flakes, Q- 2 w/cortex
<u>F17 Grid 80-100 cm</u>	
1	Trough metate fragment, SS
1	Mano fragment, unifacial, modified, SS
1	Abrading stone fragment, unifacial, modified, SS
2	Cobble abraders, Q
3	Flake abraders, Q
9	Ground stone fragments, SS
1	Parowan Basal-notched arrow point, C1
1	Knife base fragment, C1
1	Biface base fragment, C3
1	Arrow point preform, C2
1	Drill, C1
1	Drill, C6
1	Scraper, C2
1	Bifacially modified, C1
1	Unifacially modified, C1
14	Utilized flakes, C1
1	Utilized flake, C1
1	Utilized flake, Q
2	Primary flakes, C1
17	Secondary flakes, C1- 4 w/cortex
8	Tertiary flakes, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

4	Core shatter, C1
12	U/id flakes, C1
2	Secondary flakes, C2
1	Core shatter, C2
1	Secondary flake, C3
1	Tertiary flake, C6
11	Secondary flakes, Q- 6 w/cortex
1	Tertiary flake, Q
1	Core shatter, Q
1	U/id flake, Q

F17 Fill

1	Basin metate fragment, SS
1	Grinding slab fragment, SS
1	Cobble abrader, Q
1	Utilized flake, C6
1	Secondary flake, C1
1	Tertiary flake, C1
1	Secondary flake, Q
1	U/id flake, Q w/cortex

F18 40-65 cm

2	Utilized flakes, C1
2	Utilized flakes, C2
1	Secondary flake, C1

F19 on purple clay

1	U/id flake, C1

F19 beneath/in clay floor

1	Cobble abrader, Q

Pit Structure 4

1	Ground stone fragment, SS
1	Tertiary flake, C1

Pit Structure 4 Fill

1	Slab metate, SS
1	Trough metate, SS
1	Basin metate fragment, SS
1	Mano, one-hand, unifacial, modified, SS
1	Mano fragment, unifacial, modified, leading-following, SS
1	Abrading stone, bifacial, modified, SS
3	Cobble abraders, Q
1	Gypsum nodule
2	Utilized flakes, C1
1	Hammerstone, C1
2	Secondary flakes, Q- 1 w/cortex

Pit Structure 4 Fill, top of definition 110 cm?

1	Mano fragment, two-hand, unifacial, modified, leading-following, SS (Fits with fragment from F25 vicinity of overlying Pit Structure 2 "bench")
1	Cobble abrader, Q
1	Ground stone fragment, SS
2	Bifacially modified, C1
1	Cobble scraper, Q
6	Utilized flakes, C1
1	Utilized flake, C3
3	Secondary flakes, C1
2	Tertiary flakes, C1
1	Core shatter, C1
1	Secondary flake, C2
1	Tertiary flake, C3
2	Secondary flakes, Q w/cortex

Pit Structure 4 Fill (upper A and B-17) 100-120 cm

1	Mano fragment, unifacial, modified, leading-following, SS
1	Edge pounder, C1
1	Core scraper, C1
2	Utilized flakes, C1
1	Utilized flake, Q

Pit Structure 4 Fill 140-160

1	Cobble abrader, Q
1	Ground stone fragment, SS
1	Core shatter, C1

Pit Structure 4 Floor contact

1	Core shatter, C1

F23 Surface contact

1	Secondary flake, C1

Pit Structure 12 Hearth fill, South side

1	Utilized flake, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

Pit Structure 13 Fill

1	Ground stone fragment, SS
1	Secondary flake, C1
1	Mineral/hematite, pink-red
1	Secondary flake, Q w/cortex

Pit Structure 15 Association with lower pit

1	Bifacially modified, C1
1	Core, C2
1	Utilized flake, C1
1	Secondary flake, C1

Pit Structure 17 Fill

1	Abrading stone, bifacial, modified, SS
5	Cobble abraders, Q

Excavation Units

A-17 50-60 cm

2	Flake abraders, Q
2	Ground stone fragments, SS
1	Bull Creek arrow point, C2
1	Preform, C1
1	Bifacially modified, C1
1	Flake scraper, Q
14	Utilized flakes, C1
1	Utilized flake, Q
1	Primary flake, C1
14	Secondary flakes, C1- 5 w/cortex, 1 heat treated
8	Tertiary flakes, C1
1	Core shatter, C1
6	U/id flakes, C1- 1 w/cortex
3	Secondary flakes, C2
1	Secondary flake, C4 w/cortex
1	Bifacially modified, C1
1	Core scraper, C1
1	Core remnant, C5
16	Utilized flakes, C1
5	Utilized flakes, Q
1	Primary flake, C1
25	Secondary flakes, C1- 4 w/cortex, 2 heat treated
14	Tertiary flakes, C1
14	Core shatter, C1
15	U/id flakes, C1- 2 w/cortex, 3 heat treated

Pit Structure 15 Association in Pit Structure 1

1	Edge grinder, Q
1	Knife, C3
1	Preform, C3
1	Utilized flake, C1
1	Secondary flake, C1 w/cortex
1	Core shatter, C1

F40 Fill

2	Utilized flakes, C1
1	Secondary flake, C2
1	U/id flake, C6
8	Secondary flakes, Q- 3 w/cortex

A-17 60-80 cm

1	Abrading stone, unifacial, unmodified, Q
1	Disk, SS
1	Modified stone, SS
1	Polishing stone, Q
1	Cobble abrader, Q
24	Ground stone fragments, SS
2	Iron ore/hematite fragments
1	Bull Creek arrow point, C2
1	Arrow point mid-section fragment, C1
2	Knife tip fragments, C1
2	Knife mid-section fragments, C1
1	Knife base fragment, C1
1	Biface base fragment, C1
1	Drill, C2
1	Scraper, C1
3	Secondary flakes, C2- 1 w/cortex
1	Tertiary flake, C2
2	Core shatter, C4
1	U/id flake, C4
1	Primary flake, C5
2	Secondary flakes, C5
1	Tertiary flake, C5
1	Secondary flake, C6
1	Primary flake, Q
6	Secondary flakes, Q- 4 w/cortex
1	Tertiary flake, Q
4	Core shatter, Q

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

2	U/id flakes, Q
A-17 80-90 cm	
1	Secondary flake, C1
A-17 80-100 cm	
3	Cobble abraders, Q
1	Parowan Basal-notched arrow point, C1
A-17 90-100 cm	
1	Mano fragment, unifacial, modified,
5	Core shatter, C1
6	U/id flakes, C1
1	Secondary flake, C5
1	Secondary flake, Q
2	U/id flakes, Q
A-17 Block SW corner, 70-110 cm	
1	Basin metate fragment, SS
1	Mano fragment, two-hand, unifacial, modified, SS
1	Cobble abrader, Q
1	Ground stone fragment, SS
1	Secondary flake, Q
A-18 40-65 cm	
2	Ground stone fragments, SS
1	Parowan Basal-notched arrow point, C1
9	Secondary flakes, C1- 1 w/cortex
3	Tertiary flakes, C1
9	Core shatter, C1
10	U/id flakes, C1
3	Secondary flakes, C2- 2 heat treated
1	Tertiary flake, C3
1	Primary flake, C4
1	Tertiary flake, C4
1	Core shatter, C4
3	Secondary flakes, C6
1	Tertiary flake, C6
11	Secondary flakes, Q- 6 w/cortex
1	Core shatter, Q
A-18 85-105 cm	
1	Trough metate, SS
2	Awl sharpener/smoothing stones, SS
1	Mano fragment, unifacial, modified, leading-following, SS
1	Abrading stone, unifacial, modified, Q
1	Cobble abrader, 1
3	Flake abraders, Q
5	Ground stone fragments, SS
11	Utilized flakes, C1
1	Utilized flake, C6
14	Secondary flakes, C1- 3 w/cortex
5	Tertiary flakes, C1
1	Core shatter, C1
5	U/id flakes, C1
1	U/id flake, C2
3	Secondary flakes, Q- 2 w/cortex
1	U/id flake, Q w/cortex
A-18 65-85 cm	
1	Disk, SS
1	Flake abrader, Q
2	Ground stone fragments, SS
1	Rose Spring arrow point, C1
1	Arrow point fragment, C2
2	Unifacially modified, C1
1	Flake scraper, C1
1	Flake scraper, Q
19	Utilized flakes, C1
1	Utilized flake, C6
3	Primary flakes, C1
18	Secondary flakes, C1- 3 w/cortex
13	Tertiary flakes, C1
1	Abrading stone, unifacial, modified, Q
1	Disk, SS
1	Cobble abrader, Q
2	Flake abraders, Q
13	Ground stone fragments, SS
1	Scraper, C1
1	Hammerstone or polishing stone, Q
1	Flake scraper, Q
12	Utilized flakes, C1
1	Utilized flake, C2
1	Utilized flake, C4
1	Utilized flake, Q
11	Secondary flakes, C1- 3 w/cortex
13	Tertiary flakes, C1

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

5	Core shatter, C1
7	U/id flakes, C1- 2 heat treated
1	Secondary flake, C2
1	Tertiary flake, C2
1	Core shatter, C2
<u>BB-17 60-80 cm</u>	
1	Disk, SS
1	Disk fragment, SS
2	Ground stone fragments, SS
9	Utilized flakes, C1
1	Utilized flake, C4
2	Primary flakes, C1
9	Secondary flakes, C1
6	Tertiary flakes, C1
1	Core shatter, C1
5	U/id flakes, C1- 2 w/cortex
1	Tertiary flake, C3
1	Secondary flake, C4
1	Secondary flake, C5
1	Tertiary flake, C5
2	Tertiary flakes, C8
4	Secondary flakes, Q- 3 w/cortex
2	Core shatter, Q
1	U/id flake, Q w/cortex
<u>B-17 50-60 cm</u>	
4	Utilized flakes, C1
1	Primary flake, C1
7	Secondary flakes, C1- 1 w/cortex
6	Tertiary flakes, C1
2	U/id flakes, C1
3	Secondary flakes, C2
<u>E-14 80-100 cm</u>	
1	Mano fragment, unifacial, modified, leading-following, SS
1	Mano fragment, unifacial, modified, SS
2	Flake abraders, Q
2	Ground stone fragments, SS
1	Knife base fragment, C1
1	Biface tip fragment, C5
1	Scraper, C2
15	Utilized flakes, C1
11	Secondary flakes, C1- 3 w/cortex
1	Tertiary flake, C1
2	Core shatter, C1
1	Primary flake, C3
1	Secondary flake, C5
3	Secondary flakes, Q w/cortex
1	U/id flake, Q
1	Knife base fragment, C2
1	Bifacially modified, C1
8	Utilized flakes, C1
1	Utilized flake, C2
10	Secondary flakes, C1- 3 w/cortex
7	Tertiary flakes, C1
1	Core shatter, C1
2	U/id flakes, C1
1	Tertiary flake, C6
1	U/id flake, C6
2	Secondary flakes, Q- 1 w/cortex
<u>B-17 60-80 cm</u>	
5	Utilized flakes, C1
1	Utilized flake, C2
2	Secondary flakes, C1- 1 heat treated
<u>B-17 80-100 cm</u>	
1	Biface base fragment, C1
1	Bifacially modified, C1
8	Secondary flakes, Q- 4 w/cortex
<u>E-17 80-100 cm</u>	
1	Mano fragment, unifacial, modified, SS
1	Cobble abrader, Q
1	Drill, C1
1	Scraper, C1
2	Bifacially modified, C1
1	Unifacially modified, C1
1	Flake scraper, Q
2	Core scrapers, C1
1	Core, Q
6	Utilized flakes, C1
3	Secondary flakes, C1
3	Tertiary flakes, C1
1	Core shatter, C1
2	U/id flakes, C1
1	Tertiary flake, C6
3	Secondary flakes, Q- 1 w/cortex
1	Core shatter, Q

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

2	U/id flakes, Q
1	U/id flake, L
E-17 100-120 cm	
1	Abrading stone, unifacial, modified, SS
3	Cobble abraders, Q
1	Sphere, SS (natural concretion)
1	Ground stone fragment, SS
1	Maul?, SS
5	Utilized flakes, C1
1	Utilized flake, C6
1	Tertiary flake, C1
2	U/id flakes, C1- 1 heat treated
1	Secondary flake, C2
1	Secondary flake, Q w/cortex

Provenience Charts - 42Ka3976 Lithic and Ground Stone Tools Continued.

Chapter 8
Analysis of Ground Stone Artifacts

by
Barbara W. Frank

A total of 449 artifacts identified as ground stone were recovered from excavations at 42Ka3976. The artifacts were categorized into types based on each specimen's morphological and technological attributes. These attributes were identified through macroscopic examination, low-power magnification, and use of a 20X binocular microscope. In addition, artifact classification and description was directed by the typology devised by Woodbury (1954) and previous work conducted by the author (Dalley and McFadden 1988; Walling et al. 1986; Walling and Thompson 1986, 1988). Principle artifact types include: metates, grinding slabs, manos, tool abrading/sharpening platforms, abrading stones, polishing stones, edge grinders, cobble edge abraders, flake abraders, modified stone, spheres, and other miscellaneous categories. Definitions for the ground stone tool types and descriptions of the artifacts recovered from the excavations conducted at this site follow.

GROUND STONE TOOL DEFINITIONS AND DESCRIPTIONS

Metates

Trough and basin metates are defined as stone slabs on which food materials have been ground in a back-and-forth motion, which, in turn forms an ovoid to rectangular basin or trough in the surface of the stone. The utilized stone is frequently modified by pecking or grinding, while the grinding area is initially prepared by pecking in order to form an abrasive use surface. Once the basin has been ground smooth, it is repecked to maintain its abrasive qualities. A trough metate differs from an enclosed basin metate, as the trough is open or adjacent to one end of the utilized slab.

A slab metate shows use on most of the upper surface of the stone slab, particularly from end to end. And, although the use surface is pecked, a full basin or trough does not develop from use. Slight concavities do form, but due to the larger use surface and the assumed use of larger, two-hand manos with these metates, they are not the pronounced depressions of the basin metates.

A total of twelve metates were identified within the collection, including four trough metates, seven basin metate fragments, and a complete slab metate. The slab metate was recovered from Pit Structure 4 fill, and it is a smaller example, made of a fairly thick piece of sandstone (Fig. 8.1). It is a generally ovoid piece of stone exhibiting pecking and limited abrading on the laterals, as well as the basal surface. The upper surface has been throughly pecked, and the majority of it has been ground from use. There is a slight rim at the distal end of the use surface and along one lateral. A slight concavity has formed, measuring a maximum of .3 cm deep. The utilized

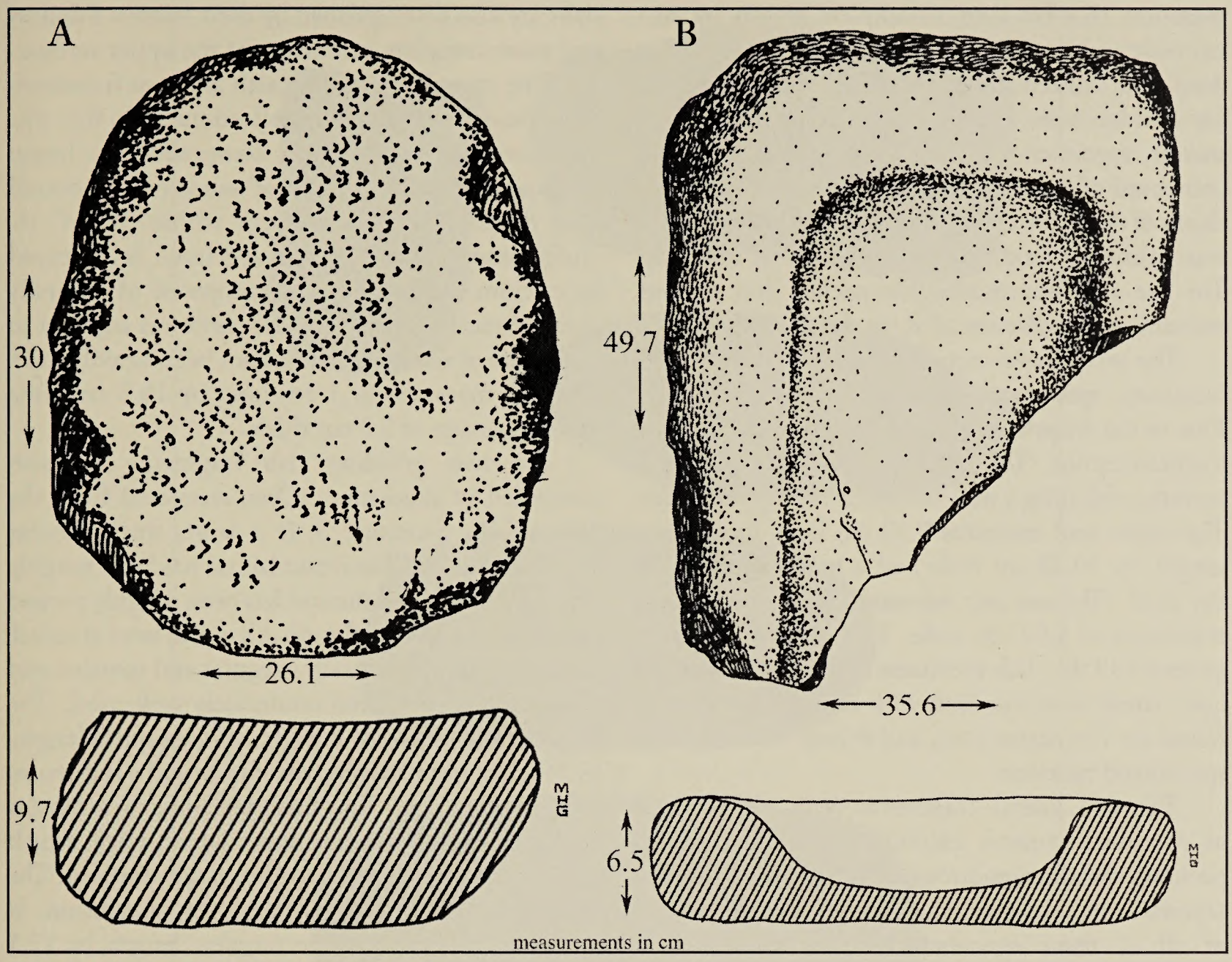


Figure 8.1. Metates: (A) slab; (B) trough.

stone measures 30 cm long by 24 cm wide and 9.7 cm thick, with the use surface measuring 26.1 cm long by 20.1 cm wide.

One complete trough metate, one largely complete specimen, and two trough metate fragments were recovered from excavations at this site. The complete example is small, measuring 12.2 cm long by 14.2 cm wide and a maximum of 3.17 cm thick. It is composed of a tabular piece of sandstone, and it exhibits an ovoid use basin adjacent to both ends of the slab. The basin measures an average of 9.9 cm wide and a maximum of .6 cm deep. The entire upper surface of the metate has been smoothly ground, but the rest of the utilized stone is generally unmodified. It was recovered from a depth of 85 to 105 cm in A-18.

The largely complete trough metate is lacking a proximal corner, including a portion of the open-end basin and lateral (Fig. 8.1). It was recovered from Pit Structure 4 fill, consisting of a tabular slab of modified sandstone which measures 49.7 cm long by 35.6 cm wide and a maximum of 6.5 cm thick. The slab laterals have been moderately shaped by pecking and abrading, while the entire basal surface has been pecked and abraded flat. The upper surface has been pecked and ground generally flat along the laterals, and a shelf is present at the distal end of the basin. It is still somewhat naturally irregular. The basin has been entirely pecked and ground, the sides are generally vertical, and the ends slope up, particularly the distal end. The basin measures 32.5 cm long by 22.3 cm wide and a maximum of 4.6 cm deep. This specimen is reminiscent of a metate variety frequently described as a Utah type, although the mano shelf at the distal end is not clearly defined.

The two trough metate fragments include one open ended portion of a use basin, recovered from the 180 to 200 cm level within Pit Structure 3. It

measures 16.4 cm long, incomplete length, by 20.1 cm wide and it exhibits a use basin averaging 2.8 cm deep. The utilized stone is naturally abrasive and the use area has been heavily utilized. The final trough metate specimen consists of a corner fragment composed of sandstone, and it was recovered from a depth of 80 to 100 cm within F17. The utilized stone was primarily modified by pecking and abrading. The use area was thoroughly pecked and ground, measuring a maximum of .8 cm deep.

The seven basin metate fragments consist of six sandstone specimens and a single basalt example. Five of the fragments are lateral sections, and one is a central section. This latter specimen is from a small metate, exhibiting a well-defined, 1.6 cm deep, basin. The entire tool measures 9.12 cm long, incomplete length, by 10.28 cm wide and a maximum of 5.39 cm thick. The use area measures 6.38 cm long by a maximum of 6.92 cm wide. It was recovered from general F17 fill. This specimen is unusual in that it is quite small in comparison with the average metates found on Formative sites, and it may have served a specialized function.

The five lateral fragments were all portions of modified metates exhibiting combinations of pecking, abrading, and rough flaking to form flat or tapered sides. In general, the lower, basal, surfaces of all of these specimens exhibit some degree of abrading. Three of these include intact basin sections, which generally exhibit abrasive pecking and extensive grinding. These specimens range from 4.01 to 7.5 cm deep. The single basalt specimen was recovered from a depth of 185 to 210 cm in the fill of Pit Structure 2. One each of the remaining four lateral fragments, all composed of sandstone, were recovered from general Pit Structure 4 fill, the southwest corner of the A-17 block at a depth of 70 to 100 cm, Pit Structure 3 fill at a depth of 180 to 200 cm, and from Pit Structure 1 fill at a depth of 240 to 260 cm.

Grinding Slabs

Grinding slabs are defined as tabular rocks which exhibit grinding on a surface, but lack the pecking and repecking which forms the basins and troughs of metates. Consequently, a well-defined basin rarely forms on the use surface, although occasionally a slight concavity may exist. Grinding slabs are also distinguished by their relative thinness and more complete utilization of the upper surface.

One complete grinding slab and two fragments were identified within the collections from this site. The complete example was composed of a heavy, irregular, unmodified piece of sandstone recovered at a depth of 80 to 100 cm within grid F-16. Unfortunately most of this specimen is obscured by calcium carbonate. It is composed of naturally abrasive sandstone and the use surface is adjacent to both ends of the stone. It has not been heavily used. The slab measures 17.1 cm long by 16.8 cm wide and an average of 5.5 cm thick.

The two grinding slab fragments are also composed of sandstone. One, recovered from the floor of Pit Structure 3, is a large, thick, tabular corner fragment. The intact lateral has been roughly bifacially flaked and the end has been roughly pecked and abraded. The basal surface has also been abraded. The use surface is naturally irregular and abrasive, and it appears to have been moderately well-used. The fragment measures 26.5 cm long, incomplete length, by 19.1 cm wide, incomplete width, and a maximum of 4.36 cm thick. The final specimen is a tabular fragment exhibiting one intact lateral edge, which has been roughly unifacially flaked and abraded. The use surface exhibits obvious evidence of abrasion. It measures 15.2 cm long, incomplete length, by 12.1 cm wide, incomplete width, and a maximum of 3.27 cm thick. It was recovered from general (F17) fill.

Awl Shaper/Sharpeners

These tools are apparently used for shaping and sharpening rounded, tapering wood and bone artifacts, such as awls. They are primarily pieces of abrasive stone, principally sandstone, which exhibits ground, longitudinal groove(s) on one or more surfaces. These grooves appear to be the result of drawing thin, cylindrical bone or wooden artifacts across the stone surface. This action forms the groove, which is frequently tapered, and tends to be wide and deeper in its central portion. Two of these artifacts were found at this site, both are composed of sandstone and they were recovered from the 85 to 105 cm level within A-18. The first is a hand-held, generally rectangular piece of stone measuring 13.7 cm long by 8.94 cm wide and a maximum of 4.41 cm thick (Fig. 8.2A). The upper surface is flat and it has been smoothly abraded, while the remainder

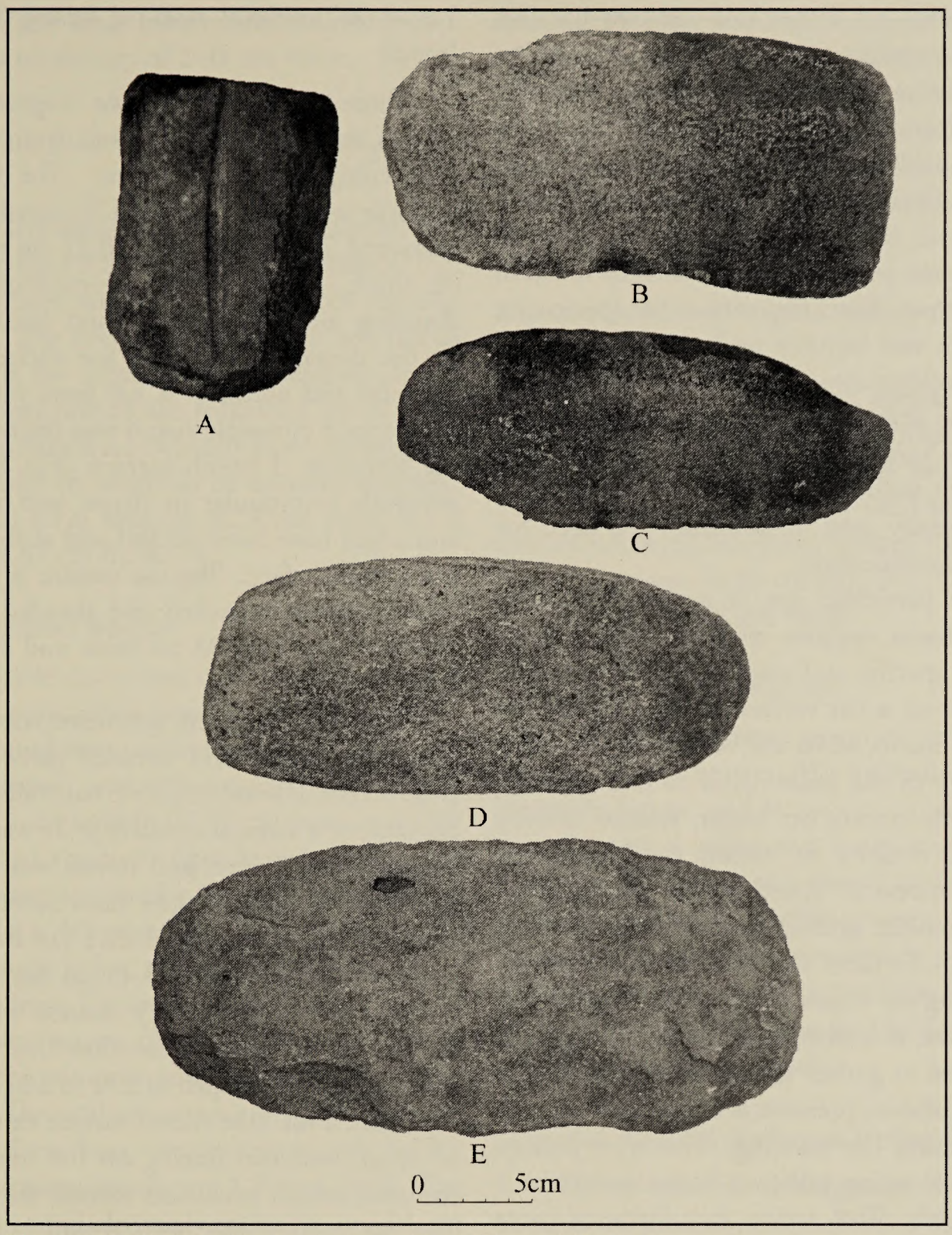


Figure 8.2. Selected ground stone: (A) awlshaper; (B-E) manos.

of the utilized stone has been minimally modified. A single, tapered, abraded groove runs at an angle across the upper surface, and it is adjacent to one end of the stone. The groove is smoothly abraded and it measures a maximum of 11.43 cm long by .49 to .91 cm wide and a maximum of .45 cm deep.

The second specimen is also a hand-held stone which exhibits minimal shape modification, primarily in the form of abrasion. The upper surface is flat and two grooves are present. Both are adjacent to the ends of the utilized stone which measures 7.08 cm long by 4.94 cm wide and a maximum of 2.72 cm thick. The more well-defined groove runs generally widthwise across the stone and it measures 5.13 cm long by .77 to .98 cm wide and a maximum of .8 cm deep. The second groove is less well defined and it runs on an angle across the use surface. It measures 2.94 cm long by .52 to .74 cm wide and a maximum of 0.2 cm deep. This groove does taper slightly on one end.

Manos

Manos are generally tabular pieces of stone which are held in the hand(s) and used in a reciprocal motion on a processing/ preparation platform, such as a metate or grinding slab. They are used for processing plants, other food materials, and

minerals. Manos are either one- or two-handed, modified or unmodified tabular stones or cobbles, which have been either unifacially or bifacially used. Modification generally refers to the shape of the stone, including rough unifacial and bifacial hard-hammer flaking and pecking and/or abrading along the lateral and end margins. Occasionally, notches have been pecked along the laterals to aid in gripping the stone. For a majority of the specimens, the use surface was initially pecked so that it was abrasive. Repecking also occurs on some specimens to maintain the abrasive surface, after continued use has ground the surface smooth. Naturally coarse or vesicular stones, such as sandstone, basalt or diorite, were also generally used to minimize the need for continual use modification.

Further, a particular use of a particular form of mano on basin metates and/or grinding slabs tends to form specific and associated wear patterns. In general, use on a flat surface produces a flat use surface on the mano, while use within a basin often causes beveling of the ends. End to end beveling more frequently occurs on larger, tabular manos, as the smaller cobbles fit within the basins and beveling does not occur. Another wear pattern is the result of the general grinding motion which forms a lateral bevel. To form this oblique wear pattern, the person using the mano raises the far edge on the beginning of the downstroke to allow the material being processed to gather under the stone. While doing this, additional pressure is applied to the near edge, which causes the beveling. This wear pattern can occur while using either a basin metate or a flat grinding slab. This action may form, or cause the need for, a wider leading lateral and a tapered, thinning, following edge. The inclusion of leading and following laterals in the design of the mano allows for a less laterally beveled or flat use surface.

Manos were the most numerous single class of ground stone artifacts recovered from 42Ka3976, consisting of eight complete examples and 42 fragments. They have been classified according to size, one- or two-hand varieties, whether they were used unifacially or bifacially, and if they exhibited well-defined leading and following laterals. In all, ten varieties of manos were identified within the collection and they will be discussed in order of most distinguishing to least distinguishing characteristics as previously mentioned.

Two-hand, unifacial, modified, leading-following laterals

Three complete and two fragmentary manos of this variety were recovered from this site. All were composed of sandstone. The first complete example was recovered from Excavation Unit C. It measured 20.6 cm long by 10.21 cm wide and 3.74 cm thick. The utilized stone exhibits pecking and abrading along the laterals and minimal grinding on the dorsal surface. The use surface is naturally irregular and abrasive. It has been minimally used. The second complete mano was recovered from the Pit Structure 3 bench surface (Fig. 8.2B). It was generally rectangular in shape, and all lateral and end edges have been pecked and abraded, as well as the dorsal surface. The use surface is flat and it has been completely pecked and abraded. It measures 20.9 cm long by 9.93 cm wide and a maximum of 3.48 cm thick.

The third complete specimen was a thoroughly modified, pecked and abraded piece of sandstone (Fig. 8.2C). The use surface is naturally irregular, also containing a natural concavity. It was also entirely pecked and abraded, and it was well used. It was recovered from the upper floor surface of Storage Room 1 and it measured 21.5 cm long by 9.6 cm wide and a maximum of 3.43 cm thick.

The two fragmentary manos of this variety were collected from Excavation Unit D. One was recovered from a depth of 190 to 210 cm within Pit Structure 2 fill. The dorsal surface exhibits evidence of rough unifacial flaking on the margins to form the tool, which constricts toward the broken edge. The use surface has been completely pecked and then smoothly ground. It measures 17.7 cm long by 6.99 to 9.89 cm wide and a maximum of 2.4 cm thick. The final fragment of this type consisted of two pieces which fit together. One fragment was recovered from Burial 2 (F25) in the vicinity of the overlying Pit Structure 2 bench, while the other was from the pit structure fill at the top of its definition at 110 cm below the modern surface. The dorsal surface angles down toward the following lateral, which has been roughly unifacially flaked along the ventral surface. The leading lateral and end edges have been modified by pecking and abrading. The use surface is flat and smoothly ground, exhibiting minimal evidence of the initial abrasive pecking. It

measures 17.5 cm long, incomplete length, by 9.7 cm wide and a maximum of 2.49 cm thick.

Two-hand, bifacial, modified, leading-following laterals

One complete sandstone mano of this variety was recovered from the Pit Structure 3 bench surface (Fig. 8.2D). It has been well modified, by both pecking and abrading. The dorsal surface, which was not as heavily used, is flat adjacent to the leading lateral, and angled down toward the following lateral. The primary use surface has obviously been pecked and repecked in order to maintain its abrasive qualities. It measures 20.4 cm long by 8.25 cm wide and a maximum of 2.87 cm thick.

Two-hand, unifacial, modified

One complete mano and two fragments of this variety, all composed of sandstone, were distinguished within the ground stone collection (Fig. 8.2E). The complete specimen was a large and heavy mano measuring 27.1 cm long by 12.44 cm wide and 4.09 cm thick. All of the tool edges have been roughly flaked and battered, as well as pecked and abraded. The use surface is generally flat and naturally abrasive, although it has not been heavily used. It was recovered from Excavation Unit C fill. One of the fragmentary manos of this variety consists of two pieces which comprise roughly two-thirds of the original tool. The utilized stone is generally tabular, measuring 17.5 cm long, incomplete length, by 9.8 cm wide, incomplete width, and 1.89 cm thick. The use surface is flat and obviously pecked to provide an abrasive surface. It was recovered from Pit Structure 2 spoil.

The final fragment of this variety was recovered from the 70 to 100 cm level within the southwestern corner of the A-17 block. The utilized stone was modified by pecking and abrading, and finger grooves were present on the extant laterals. The use surface had been ground flat and the natural abrasiveness of the stone precluded the need of extensive pecking. It measures 14.5 cm long, incomplete length, by 11.06 cm wide and 5.54 cm thick.

One-hand, unifacial, modified, leading-following laterals

One complete mano of this type was recovered from the Pit Structure 2 spoil vicinity. It is composed of quartzite and it measures 10.08 cm long by 9.84 cm wide and a maximum of 7.15 cm thick. The utilized cobble exhibits minimal modifying pecking on the edges and dorsal surface. The use surface was ground flat and smooth, and the central area exhibits some evidence of pecking.

One-hand, bifacial, modified, leading-following laterals

A fairly heavy, sandstone, cobble mano of this type, exhibiting pecking and abrading along the edges, was recovered from spoil near the floor of Pit Structure 1. The primary use surface is slightly convex, while the secondary surface has been ground flat. It measures 10.82 cm long by 9.13 cm wide and a maximum of 5.31 cm thick.

One-hand, unifacial, modified

A single sandstone mano of this variety was recovered from general Pit Structure 4 fill. It is generally square and it appears to have originally been part of a larger two-hand mano which had broken. The edges and dorsal surface have been pecked and abraded, and finger grooves are present along the laterals. The use surface was thoroughly pecked and abraded, and the tool has been well used. It measures 12.65 cm long by 11.94 cm wide and a maximum of 4.94 cm thick.

Unifacial, modified, leading-following laterals

Twenty-two mano fragments of this variety occur in the ground stone collection from the site; all are composed of sandstone. Twenty are end portions and two are mid-section fragments, all of which were recovered from various stratigraphic situations, primarily fill levels (see Provenience Tables). Fifteen of the fragments exhibit flat use surfaces, while six have slightly convex ones, and one has both a flat and an angled surface. Shape modification primarily consists of pecking and abrading along both lateral and end edges, as well as on the dorsal surfaces. Six of these specimens exhibit dorsal surfaces which are flat adjacent to the leading lateral and angled down to the following lateral edge. In sum, these fragments were the most numerous type of manos recovered from this site.

Bifacial, modified, leading-following laterals fragments

Only three mano fragments of this type were identified. Two are end fragments and one is a mid-section portion. All three are composed of sandstone, and they all exhibit flat primary use surfaces. As is typical of bifacially utilized specimens, one surface was more heavily utilized then the other. One was recovered from fill overlying the Pit Structure 3 bench, one from the 200 to 220 cm level within Pit Structure 1 and one from fill 30 to 50 cm above the floor of Pit Structure 1.

Unifacial, modified fragments

Thirteen fragments of this mano variety were distinguished; all are composed of sandstone. Six are mano end fragments, five are end corner fragments, one is a mid-section fragment, and one is a lateral edge fragment. In general, these specimens exhibit flat use surfaces and they were primarily recovered from fill contexts (Provenience Tables). The exception is one fragment which was recovered from the Pit Structure 3 bench surface.

Bifacial, modified fragment

One bifacially utilized mano end fragment falls within this category. It was recovered from fill 30 to 50 cm above the floor of Pit Structure 1 and it is composed of sandstone. Both surfaces have been ground flat, and the intact edges were pecked and abraded flat.

Abrading Stones

These artifacts are abrasive stones, which are worn due to their use on a variety of materials (Fig. 8.3). They may have been used for shaping wood or bone, or for smoothing stone objects such as axes, mauls, metates, manos, or even building stone. Four classes of abrading stones were distinguished in the collection (Fig. 8.3).

Unifacial, modified

Sixteen complete and six fragmentary abrading stones of this variety were identified. In general, these tools exhibit a minimal amount of pecking and/or abrading to modify the shape of the utilized stone. They were recovered from a variety of stratigraphic situations.

The first complete specimen is composed of sandstone and it was recovered from the 190 to 210 cm level within Pit Structure 2. It is a hand-size stone exhibiting pecking on the ends and some abrading on the convex dorsal surface. One end has apparently been used as a pounding stone, and the laterals appear to have been used for pounding. The use surface is flat and smoothly abraded, exhibiting a few peck marks. It measures 8.36 cm long by 6.75 cm wide and a maximum of 3.03 cm thick. The next tool of this variety is a somewhat cylindrically shaped piece of sandstone recovered from general Pit Structure 1 fill. One end of the utilized stone has been obviously pecked and abraded flat, while the laterals and dorsal surface have been moderately pecked. The use surface has been thoroughly pecked and ground flat. This tool measures 9.35 cm long by 4.47 to 4.32 cm in diameter.

This tool consists of a minimally modified sandstone cobble which exhibits abrading on the dorsal surface and pecking on one end. The use surface has been smoothly ground, but it does not exhibit any evidence of abrasive pecking. It was recovered from a depth of 90 to 110 cm within F2 at grid CC-19 and CC-20. It measures 9.36 cm long by 5.96 cm wide and a maximum of 3.86 cm thick. The next specimen, also composed of sandstone, was recovered from a depth of 100 to 120 cm in grid E-17. It is made up of a hand-size pebble displaying leading and following laterals. The following lateral has been pecked and the convex dorsal surface appears to have been abraded. The use surface is flat and has been smoothly ground. It measures 9.97 cm long by 5.44 cm wide and a maximum of 3.56 cm thick.

The fifth specimen is a quartzite cobble, which exhibits pecking on the ends, while the use surface is naturally irregular. It measures 8.73 cm long by 6.96 cm wide and a maximum of 4.94 cm thick. It was recovered from a depth of 165 to 185 cm within Pit Structure 2. The next abrading stone is also composed of quartzite and it was recovered from the 120 to 140 cm level within Pit Structure 1. The utilized cobble exhibits pecking on the dorsal and ventral corners, and the dorsal surface exhibits sporadic peck marks. The use surface has been abraded flat and it exhibits remnants of the initial abrasive pecking. In general, this is a nicely modified tool and it measures 8.8 cm long by 6.15 cm wide and 2.64 cm thick. The

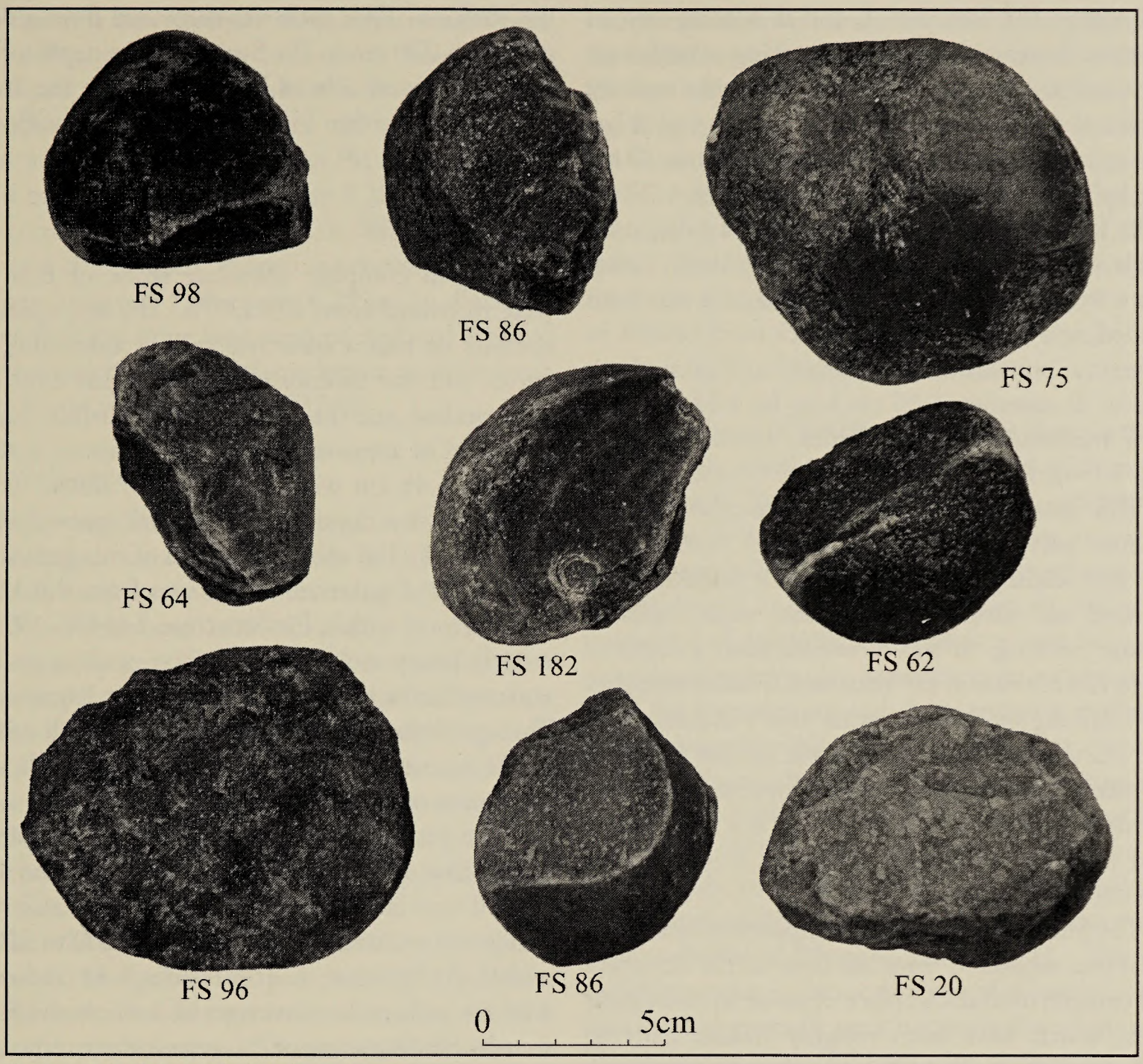


Figure 8.3. Selected abrading stones.

seventh abrading stone of this variety consists of a fairly large and heavy quartzite cobble. It exhibits minimal shape modification, consisting of pecking on the cobble ends and some abrasion on the dorsal surface. The use surface is flat and it has been smoothly ground. It measures 14.4 cm long by 9.7 cm wide and 7.17 cm thick. It was recovered from a depth of 185 to 210 cm within Pit Structure 2.

The next specimen is a minimally modified quartzite cobble which exhibits limited pecking on the ends. The use surface has been smoothly ground and it is naturally concave. It was recovered from the 145 to 155 cm level within Pit Structure 2 in grid BB-19. It measures 9.75 cm long by 8.74 cm wide and 5.13 cm thick. The next tool consists of roughly half of a quartzite cobble and it was recovered from a depth of 85 to 105 cm in A-18. The dorsal surface has been sparingly abraded and the ends, and portions of the lateral edges, have been pecked. The central portion of the flatly ground use surface exhibits evidence of abrasive pecking. It measures 6.44 cm long by 5.03 cm wide and a maximum of 2.34 cm thick.

The tenth abrading stone of this type is the only basalt specimen. At least half of the dorsal surface has been heavily pecked, removing the cortex. Both cobble ends also exhibit pecking, one more heavily then the other. The use surface is naturally undulating; it has been pecked adjacent to one lateral edge, and it has also been smoothly abraded. This tool was recovered from a depth of 120 to 140 cm within Pit Structure 1. It measures 12.06 cm long by 6.24 cm wide and 5.53 cm thick. The next specimen was recovered from the 240 to 260 cm

level within Pit Structure 1, and it is composed of quartzite. It exhibits modifying pecking at both ends of the cobble, along one lateral, and near the ends on the dorsal surface. The use surface is flat and it has been smoothly ground. This cobble measures 10 cm long by 8.73 cm wide and a maximum of 4.77 cm thick. The twelfth tool of this variety is a palm-sized pebble which has been used in a lengthwise, rather then a widthwise, manner. One end edge has been abraded, and there are abrasive peck marks visible in the central portion of the flattened and ground use surface. It measures 8.35 cm long by 4.34 cm wide and a maximum of 1.91 cm thick. It was recovered from fill overlying the Pit Structure 3 bench.

This abrading stone is a quartzite cobble, which has lost part of the dorsal surface. The cobble ends and leading lateral edge exhibit pecking. The flattened use surface also exhibits some minimal abrasive pecking. It was recovered from a depth of 100 to 120 cm within Pit Structure 3, and it measures 7.63 cm long by 4.62 cm wide and a maximum of 2.52 cm thick. The next example of this type was recovered from the floor of Pit Structure 2 and it was also composed of quartzite. It is a heavy, two-hand abrading stone measuring 17.1 cm long by 10.5 cm wide and 7.6 cm thick.

The fifteenth specimen is composed of sandstone and it was recovered from the floor of Pit Structure 1. It consists of a tabular piece of stone with irregular edges, which have been roughly flaked, battered and minimally pecked. The dorsal surface has been partially abraded, while the use surface is flat and it has been completely ground. It measures 10.73 cm long by 7.68 cm wide and 3.8 cm thick. The final complete specimen is a quartzite pebble measuring 4.66 cm long by 3.93 cm wide and 1.33 cm thick. It exhibits a flattened use surface and it was recovered from the 90 to 100 cm level within A-17.

The six fragmentary abrading stones of this type were primarily recovered from fill situations. Two are composed of sandstone and both exhibit flat use surfaces. The one recovered from a depth of 80 to 100 cm within Grid 17 exhibits leading and following laterals. The second sandstone fragment exhibits an abraded dorsal surface and laterals. It was recovered from the 180 to 200 cm level within Pit Structure 1.

All four of the quartzite abrading stone fragments exhibit smoothly ground and flattened use surfaces. One each was recovered from a depth of 200 to 220 cm in Pit Structure 1, a depth of 200 cm on the west side of Pit Structure 1, the 160 to 180 cm level within Pit Structure 3, and the floor of Pit Structure 2.

Bifacial, modified

Seven complete abrading stone of this type were recovered from 42Ka3976. The first specimen consists of half a quartzite cobble, exhibiting one cortex and one interior use surface. The ends have been pecked, and the abraded cortex surface exhibits remnants of abrasive pecking. It measures 8.48 cm long by 6.48 cm wide and 3.33 cm thick. It was recovered at a depth of 165 to 185 cm within Pit Structure 2. The second example of this type is also composed of quartzite and it was from the 155 to 165 cm level within Pit Structure 2 at CC-19. It is a fairly heavy tool, which exhibits pecking on both ends and some sporadic pecking on the lateral edges. This specimen exhibits minimal use on both surfaces and it measures 9.93 cm long by 7.87 cm wide and a maximum of 5.73 cm thick.

The next example of this variety is a quartzite cobble that exhibits pecking on both ends and along part of one lateral edge. Two surfaces exhibit use and it was recovered from a depth of 200 to 220 cm within Pit Structure 1. It measures 8.44 cm long by 4.69 cm wide and a maximum of 3.48 cm thick. The fourth abrading stone of this type is also composed of quartzite. One end of the utilized cobble appears to have been used as a pounding stone, while portions of the laterals and the other end of the cobble exhibit more limited modifying peck marks. The dorsal surface also displays peck marks, and both surfaces exhibit abrasive use. It measures 10.24 cm long by 5.49 cm wide and a maximum of 4.55 cm thick. The tool was recovered from Burial 2 in the vicinity of the overlying Pit Structure 2 bench.

The next three tools are all composed of sandstone. This first is a rough cobble exhibiting battering and some pecking along the edges. One use surface is flat and has been smoothly ground, while the other is naturally irregular and less thoroughly abraded. This tool was recovered from the floor of Pit Structure 1. It measures 6.62 cm long by 7.85 cm wide and 4.44 cm thick. The next example of this variety is a triangularly shaped piece of tabular stone. One lateral has been unifacially flaked and abraded,

such that it is now tapered. Both surfaces have been ground flat, and one has been more heavily used. This latter surface also exhibits a limited number of peck marks and evidence of widthwise use striations. It was recovered from Pit Structure 4 fill, and it measures 8.35 cm long by 7.22 cm wide and a maximum of 1.97 cm thick. The final tool of this type is a cylindrically shaped specimen measuring 7.27 cm long and 5.88 cm by 6.29 cm in diameter. The ends of the stone have been pecked and abraded flat, and two irregular surfaces appear to have been used. It was recovered from F37 fill.

Unifacial, unmodified

Four complete and two fragments of this variety of abrading stone were identified. The first example is a small sandstone pebble measuring 1.99 cm long by .95 cm wide and 1.06 cm thick. It exhibits a flat, smoothly ground surface and it was recovered from a depth of 120 to 140 cm within Pit Structure 1. The next abrading stone is a small irregularly shaped sandstone tool exhibiting a flat and smoothly ground use surface. It was recovered from the 155 to 165 cm level in Pit Structure 2 within grid CC-19. It measures 6.08 cm long by 3.39 cm wide and a maximum of 2.45 cm thick.

The third tool of this type is an irregular, somewhat triangularly shaped piece of sandstone. The flat and smoothly ground use surface exhibits widthwise use striations. It was recovered from a depth of 200 to 220 cm within Pit Structure 1, and it measures 6.06 cm long by 5.68 cm wide and a maximum of 2.05 cm thick. The final complete tool of this type is a sandstone cobble, which shows a minimal amount of abrasion on one surface. It was recovered from the 220 to 240 cm level within Pit Structure 1, and it measures 5.63 cm long by 6.26 cm wide and 6.72 cm thick.

The two fragmentary specimens of this variety are both quartzite cobble fragments, which exhibit flatly abraded use surfaces. One was recovered from a depth of 140 to 160 cm within Pit Structure 1, while the other came from the 60 to 80 cm level within grid A-17.

Bifacial, unmodified

Two abrading stones of this variety were recovered from 42Ka3976. The first is a sandstone cobble, which exhibits two minimally abraded and flattened use surfaces. It was recovered from a depth of 210 to 230 cm within Pit Structure 2, and it measures 7.95 cm long by 7.04 cm wide and a maximum of 4.08 cm thick. The second tool consists of a quartzite cobble exhibiting two minimally used surfaces. It measures 6.8 cm long by 6.27 cm wide and 4.81 cm thick. This abrading stone was recovered from the fill above Residential Room 1.

Polishing Stones

Woodbury (1954:96-97) defines these artifacts as generally small, water-worn stones with one or more nearly flat use surfaces, which exhibit fine striations, or are highly polished. These stones are usually unmodified and the use motion appears to be perpendicular to their lengths. They are frequently composed of quartzite, and they may have been used to smooth pottery, clay floors, or to grind pigments.

One fragmentary and three complete polishing stones were found at this site. The first complete example is a small quartzite pebble, measuring 4.33 cm long by 3.34 cm wide and a maximum of 2.08 cm thick. A few peck marks are evident on the pebble ends, while the use surface is flat, exhibiting some faint widthwise striations. It was recovered from a depth of 60 to 80 cm in A-17. The next polishing stone is also composed of quartzite, and it also exhibits sporadic peck marks on the cobble ends. The following lateral exhibits a few peck marks, while the use surface has been flattened and smoothed. A few, faint widthwise striations are evident on the use surface. It was recovered from the 85 to 105 cm level within grid A-18, and it measures 6.13 cm long by 4.17 cm wide and 3.14 cm thick. The final complete tool exhibited no evidence of shape modification, and it is composed of a rounded, triangularly shaped quartzite pebble. The use surface is slightly polished and it exhibits faint widthwise striations. It measures 4.9 cm long by 6.64 cm wide and 2.86 cm thick. It was recovered from a depth of 230 to 250 cm within Pit Structure 2.

The fragmentary polishing stone consists of a large portion of a quartzite pebble, which measures 6.2 cm long, incomplete length, by 3.4 cm wide and 1.76 cm thick. The intact end exhibits some evidence of pounding use, while the convex dorsal surface displays faint widthwise striations. The use

surface is flat and slightly polished. This fragment was recovered from Pit Structure 1 spoil.

Edge Grinders

Edge grinders are generally cobbles small enough to be held in the hand, and which exhibit a distinctly flattened edge created by purposeful grinding. The nature of the ground edge indicates that these tools were used on a flat, abrasive surface, probably a grinding platform. These artifacts could have been used for processing seeds or for grinding pigments and/or pottery temper, but no evidence revealing specific usages was obtained.

Three edge grinders were identified within the artifact collection from 42Ka3976. Two are composed of quartzite and one is made up of type C1 chert. The quartzite specimens are generally hand-held tools exhibiting use on a number of natural edges. The specimen recovered from a depth of 220 to 240 cm within Pit Structure 1 fill has been minimally flaked to form some of the utilized edges. It measures 7.97 cm long by 6.62 cm wide and a maximum of 5.22 cm thick. The second quartzite tool displays one heavily used and flattened edge, and it is made of a cobble fragment. It measures 6.41 cm long by 3.01 cm wide and an average of 2.54 cm thick. It was recovered from Burial 3 within the fill of Pit Structure 1.

The final edge grinder is a hand tool exhibiting both grinding and pounding on a number of broken edges and protuberances. It was recovered from F29 in Pit Structure 3, on or close to the sand surface, and it measures 6.66 cm long by 4.4 to 4.9 cm in diameter.

Cobble and Flake Abraders

Cobble and flake edge abraders are similar to edge grinders in that they exhibit well-ground use edges on generally unmodified cobble fragments and flakes. In addition, they display abraded cortex and/or interior surfaces adjacent to, and associated with the utilized edges. These smoothly abraded surfaces and the amount of grinding and rounding on the utilized edges suggest that these were primarily used on softer materials, such as hides and/or vegetal matter, in addition to those uses listed for edge grinders.

Cobble Edge Abraders

A large number, 93, of these artifacts were recovered from 42Ka3976, making it the dominant hand-held grinding tool within the collection. The majority of them, 89, are composed of quartzite cobble fragments, one is basalt, two are type C5 chert, and one is type C7 chert. In general, the quartzite specimens consist of broken cobble fragments exhibiting utilized broken edges adjacent to cortex and/or interior abraded surfaces. The use edges are both acute and steep, but they all display ground, rounded or flattened surfaces. In addition, many of them display some unifacial use scarring, primarily along the adjacent, ventral, abraded surfaces. The artifacts were recovered from a variety of stratigraphic situations (See Provenience Tables).

Sixteen of these tools exhibit limited unifacial and bifacial flaking along the utilized edge(s) and two specimens have been finely modified, with flaking, abrading, and pecking extant on the tool. Thirty of these tools have been heavily used, exhibiting extensive grinding and abrasion along the utilized edges and surfaces. A few of these cobble abraders have also been used as edge pounders. In total, these tools range in size from 2.43 cm by 2.92 cm in diameter and 2.92 cm thick to 10.93 cm by 10.33 cm in diameter and 6.12 cm thick. In general, they average between 5 cm and 6.5 cm in diameter.

Flake Edge Abraders

Thirty-six flake edge abraders were identified in the ground stone collection (Provenience Tables). Thirty-five are composed of quartzite and one is type C1 chert. Eighteen are made of secondary flakes, eleven are primary flakes, two appear to be pieces of core shatter, and the remaining five are unidentifiable flake fragments. The utilized edges range from acute to steep, and they exhibit ground, rounded, and flattened use edges adjacent to abraded cortex and interior surfaces. In addition, some flakes also displayed unifacial use scarring, primarily on the ventral surface.

In general, these tools average from 4.5 cm to 5 cm in diameter. Their uses appear similar to those ascribed for cobble edge abraders, although the utilized edges do not exhibit the extent of use and thickness of grinding area observed on the larger tools. This may suggest a more limited use for these smaller tools.

Modified Stone

Modified stones are those artifacts which exhibit shape modification by either rough unifacial or bifacial flaking or abrading, or a combination of these methods. In general, these artifacts are made of tabular sandstone. Specific artifact types within this category included disks, shaped stone, and hatch covers. Stone disks are generally circular pieces of tabular stone which may have served as capping stones for ceramic vessels, although their range of function is not known. Hatch covers, a generic term, are larger circular to rectangular shaped pieces of tabular stone used as covers for storage cist entryways, and occasionally as room or pithouse entrance covers. Methods of shape modification are similar to those employed in the modification of the smaller disks. Shaped stone artifacts serve an unknown function, and range in shape from triangular, to square, to rectangular. Some may be pendant blanks.

Disks

Thirteen complete and eleven fragmentary disks were identified within the ground stone collection. The first complete specimen is composed of sandstone and it is generally circular, measuring 6.06 by 5.91 cm in diameter and a maximum of 1.36 cm thick. The laterals are flat to slightly angled, and they have been abraded. Both surfaces are flat and abraded, with one surface more smoothly ground then the other. It was recovered from spoil near the floor of Pit Structure 1. The next specimen is largely complete, lacking less then one-quarter of the original artifact. The laterals of this generally circular sandstone disk are straight, having been roughly flaked and abraded. Both surfaces have been ground, one surface more smoothly then the other. It was recovered from a depth of 210 to 230 cm in Pit Structure 2 and it measures 6.83 cm in diameter and a maximum of 1.38 cm thick.

The third specimen was recovered from the 60 to 80 cm level within A-17, and it is also composed of sandstone. It is generally circular, exhibiting five straight, abraded sides. Both surfaces have been minimally abraded, and it measures 3.49 by 3.57 cm in diameter and a maximum of .64 cm thick. The next specimen is oddly shaped, square at one end and tapered at the other. It was recovered from a depth of 145 to 155 cm in Pit Structure 2 within grid CC-19. It measures 3.8 cm by 3.46 cm in diameter and a maximum of 0.66 cm thick. Both flat surfaces have been abraded, one surface more smoothly then the other. The fifth disk is also somewhat oddly shaped, rounded but also angled. It is generally unmodified, except for the flat surfaces which have been ground, one more smoothly then the other. It measures 4.95 by 4.03 cm in diameter and a maximum of 0.88 cm thick. It was recovered from the 165 to 185 cm level within Pit Structure 2.

The next specimen is also composed of sandstone and it is generally circular to ovoid in shape. The laterals have been abraded, one is the natural edge, while the other has been battered and ground. Both surfaces have been abraded, although one is still naturally irregular, while the other has been smoothly ground. It measures 5.18 by 4.77 cm in diameter and it ranges from 1.15 to 1.84 cm thick. It was recovered from the trash level above Pit Structure 2 (Stratum 2) at a depth of 110 to 130 cm in grid BB-19. The seventh disk is a generally circular sandstone specimen, exhibiting minimally battered and abraded lateral edges. Both flat surfaces have been ground, one more smoothly then the other. It measures 5.49 by 5.08 cm in diameter and 0.73 cm thick. It was recovered from a depth of 120 to 140 cm within Pit Structure 1.

The following specimen is larger then the previously discussed disks, measuring 7.69 by 8.06 cm in diameter and 1.75 cm thick. It is composed of sandstone and is generally circular. The majority of the edges have been roughly bifacially flaked. One surface is naturally irregular, while the other has been smoothly ground flat. This latter surface also exhibits peck marks adjacent to one edge. It was recovered from a depth of 60 to 80 cm within BB-17. The ninth complete disk is composed of layered sandstone, which is beginning to spall. It is circular, measuring 6.87 by 6.97 cm in diameter and a maximum of 1.84 cm thick. The laterals are flat to slightly convex and they have been completely abraded. Both surfaces have been ground, one more smoothly then the other. It was recovered from the 125 to 145 cm level in Pit Structure 2 within grid BB-19. The next specimen was recovered from the fill in association with the Pit Structure 3 bench and it is also composed of sandstone. It is an ovoid-square measuring 3.7 by 4.01 cm in diameter and 0.76 cm thick. The edges have been minimally abraded and both surfaces have been ground flat.

The eleventh complete sandstone specimen is generally circular, exhibiting one flat side. The laterals have been minimally battered to modify the shape of this artifact. Both flat surfaces have been ground, one more smoothly and completely then the other. It was recovered from a depth of 140 to 160 cm in Pit Structure 1. It measures 6.68 by 6.78 cm in diameter and a maximum of 1.86 cm thick. The next sandstone example is circular and the abraded laterals are flat to slightly convex. It measures 5.37 cm in diameter and 0.95 cm thick. Both flat surfaces have been ground, one more smoothly then the other. It was recovered from the 240 to 260 cm level within Pit Structure 1. The final complete disk is also composed of sandstone and it is generally rectangular in shape. One surface has been smoothly and completely ground, while the other is composed of layers of sheeted sandstone. It measures 9.6 cm long by 7.41 cm wide, and it ranges from 0.49 to 1.4 cm thick. It was recovered from the upper 10 to 15 cm of Storage Room 1 fill, during its initial clean-up and definition.

The eleven disk fragments are all composed of sandstone and they generally represent one-quarter to one-half of the original artifact. The first three were all recovered from a depth of 65 to 85 cm in A-18. One is represented by roughly one-quarter of the original disk and it exhibits a battered, arced edge. It has been bifacially ground and one surface is smoother then the other. It is a maximum of 0.44 cm thick. The second example from this provenience is represented by somewhat more then half of the original artifact. Both surfaces have been smoothly ground and it measures 3.79 cm in diameter by 0.44 cm thick. The final artifact consists of a small fragment exhibiting an arced edge. Both surfaces have been abraded, one more smoothly then the other, and it measures .47 cm thick.

The fourth fragment consists of a little more then half of the original artifact, which appears to have been circular in shape. The intact laterals are flat and they have been abraded, as have both surfaces. As is typical with artifacts of this variety, one surface has been more smoothly ground then the other. It measures 3.45 cm in diameter and a maximum of 0.73 cm thick. It was recovered from a depth of 60 to 80 cm within BB-17. The next specimen is a rounded square fragment composed of coarse grained sandstone, measuring 3.58 cm in diameter and 0.61 cm thick. One surface is naturally irregular and the other has been minimally abraded. It was recovered from the 85 to 105 cm level in grid A-8. The sixth fragment is a crescent shaped piece composed of sandstone. Both surfaces are ground flat, one more smoothly then the other. It measures 3.87 cm in diameter and a maximum of 0.73 cm thick. It was recovered from the feature midden in grid BB-19 at a depth of 90 to 110 cm.

The following fragment consists of an arced piece composed of tabular sandstone measuring 0.73 cm thick. It has been bifacially abraded, with one surface more smoothly ground then the other. It was recovered from grid F16 at a depth of 80 to 100 cm. The eighth fragment represents roughly one-quarter of the original artifact. Both surfaces have been ground, one more smoothly then the other, and it measures 0.84 cm thick. It was recovered from a depth of 100 to 120 cm within grid F-15. The next fragment was recovered from the 160 to 180 cm level within Pit Structure 3. It consists of roughly half of an ovoid square to rectangular example. The intact laterals are abraded, and both surfaces have been ground, one more smoothly then the other. It measures 2.74 cm in diameter and 0.68 cm thick.

The tenth sandstone fragment represents approximately one-quarter of the original artifact. Both flat surfaces have been ground, one more smoothly then the other. It was recovered from a depth of 230 to 250 cm in Pit Structure 2, and it measures 0.88 cm thick. The final fragment is also composed of sandstone, and consists of about one-quarter of the original disk. The intact tapered lateral edge has been roughly flaked, and both surfaces have been ground, one more smoothly then the other. It measures a maximum of 0.74 cm thick and it was recovered from the upper clay fill of the hearth in Pit Structure 2.

Hatch Cover

Two specimens in this category were recovered, one broken but complete and one fragment. The hatch cover fragment was recovered from the 230 to 250 cm level within Pit Structure 2. It has tapered edges that have been unifacially flaked on opposite surfaces. Both flat surfaces have been abraded, although one has been more smoothly and completely ground. It measures 24.5 cm long, by

8.6 to 11.5 cm wide with a maximum thickness of 1.51 cm.

A second dressed sandstone slab was initially found partially exposed in the fill of the Feature 4 niche/tunnel (Fig. 3.21). Although its actual function is speculative, the artifact compares well in size and shape with slabs used to seal storage rooms entries. It is made from a thin, brown Moenkopi Sandstone slab with ripple marks. It measures 65 cm long by 50 cm wide and 2 cm thick (Fig. 8.4).

Modified/Shaped Stone

Three complete and seven shaped stone fragments, all composed of sandstone, were identified in the ground stone collection. The first is a small subsquare, subcircular piece of tabular stone measuring 3.3 cm by 3.28 cm and 0.72 cm thick. It has been bifacially ground, with one surface more smoothly finished then the other. It was recovered from general Pit Structure 1 fill. The second complete specimen is a square to rectangular shaped piece of stone recovered from a depth of 60 to 80 cm within F-17. One edge appears to have been roughly battered, and both surfaces have been ground, one more smoothly then the other. It measures 4.48 cm by 4.68 cm and .58 cm thick. The final complete specimen is a generally square piece of layered sandstone. The laterals exhibit some minimal unifacial flaking and abrading. Both surface have been ground flat, although one has been more smoothly and completely abraded. It measures 4.91 cm by 4.49 cm and a maximum of 1.51 cm thick.

The first of the shaped stone fragments is a piece of thin tabular stone including an intact modified lateral. The stone exhibits a surface layer of silty carbonate, and it may have originally been designed as a pendant blank. The carbonate layer is softer and smoother then the sandstone component. This piece measures 4.87 cm long, incomplete measurement, by 4.37 cm wide and 0.64 cm thick. It was recovered from general Pit Structure 1 fill. The next fragment exhibits one smoothly ground surface and an abraded lateral edge. It measures 0.5 cm thick and it was recovered from a depth of 155 to 165 cm in Pit Structure 2 fill. The third fragment represents roughly one-quarter of the original angular artifact. It has been bifacially ground, with one surface more smoothly and completely abraded. It measures 0.63 cm thick and was recovered from the 110 to 130 cm level in Pit Structure 2 in grid CC-19. The fourth specimen exhibits intact abraded edges, and it measures maximum of 0.59 cm thick. Both flat surfaces have been ground, one more smoothly then the other. It was recovered from grid 16, in fill above Pit Structure 1.

The next specimen is a larger piece of stone, possibly a hatch cover fragment. The intact lateral edge has been roughly bifacially flaked. Both surfaces have been smoothly ground, and it measures an average of 1.83 cm thick. It was recovered from a depth of 185 to 210 cm in Pit Structure 2 fill. The sixth fragment appears to be the basal section of a triangular or rectangular piece. One surface and the flat laterals have been smoothly abraded, while the opposite surface is also flat. It measures 3.06 cm long, incomplete length measurement, by 3.17 to 3.9 cm wide and 0.63 cm thick. It was recovered from Pit Structure 3 fill at a depth of 160 to 180 cm. The final fragment is a larger piece of stone measuring 13.65 cm long by 10.41 cm wide, incomplete width, and 1.83 cm thick. Two of the three intact edges exhibit rough unifacial flaking and abrading, and both surfaces have been ground. It was recovered from a depth of 230 to 250 cm in Pit Structure 2.

Spheres

Six spheres were identified among the ground stone artifacts. All are largely complete. The first is composed of fine-grained basalt, and it appears to be a largely natural form, exhibiting limited evidence of pecking and abrading on a few sections of the surface. It presently displays a number of natural cracks. It measures 5.17 cm by 5.1 cm in diameter and 4.08 cm thick. It was recovered from a depth of 210 to 231 cm in Pit Structure 2 fill. The second sphere is a minimally modified quartzite example, exhibiting a few areas of surface pecking. It measures 4.56 cm by 4.52 cm in diameter, and it was recovered from the 120 to 140 cm level within Pit Structure 1 fill.

The third artifact of this type is a largely complete, ovoid, sandstone specimen. Roughly one-quarter of the original sphere is missing and it exhibits minimal areas of pecking and/or abrading. It measures 5.14 cm long by 3.97 cm in diameter, and it was recovered from a depth of 140 to 160 cm in Pit Structure 1 fill. The next sphere is also composed of sandstone, and

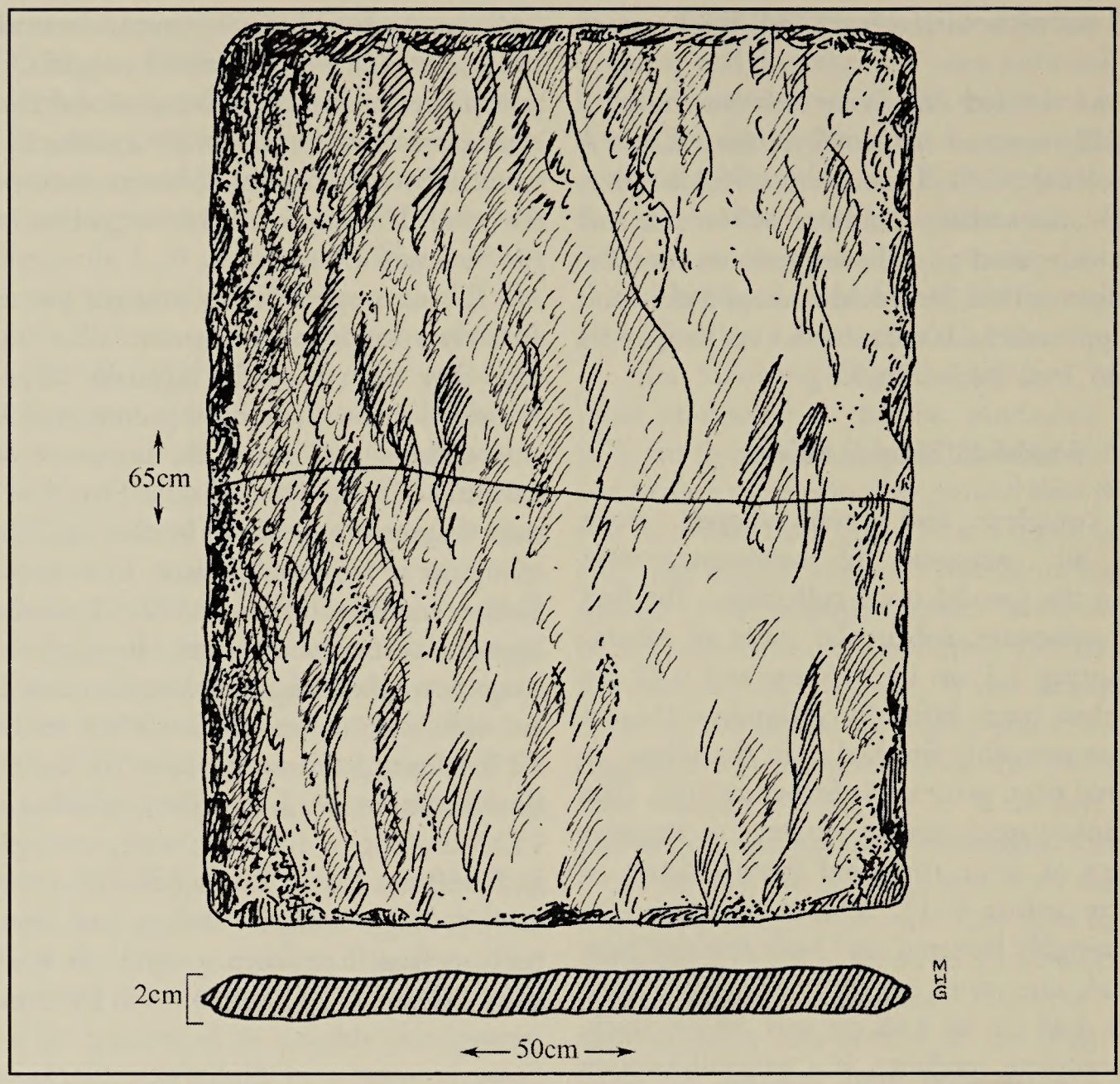


Figure 8.4. Dressed sandstone slab from Feature 4 niche/tunnel.

it appears to be a natural form, exhibiting pecking on one area. It measures 5.26 cm long by 4.37 to 4.42 cm in diameter. It was recovered from the 155 to 165 cm level within Pit Structure 2 fill in grid CC-19. The next sphere is composed of type C6 chert. Over 90 percent of the surface displays evidence of pecking and pounding, particularly on the cobble ends. It measures 5.5 cm long and 4.41 to 4.47 cm in diameter. This artifact was recovered from 10 cm above, to contact with, the floor of Pit Structure 1.

The final sphere is a natural sandstone concretion which is somewhat ovoid, measuring 4.32 cm by 3.87 cm in diameter. It exhibits sporadic surface pecking and abrading, and it was recovered from a depth of 185 to 210 cm in Pit Structure 2 fill.

Hoe

A possible hoe was recovered from the spoil in front of Pit Structure 3. It is a small tool, composed of sandstone. It exhibits limited evidence of modification or use. The surfaces display some apparent pecking and abrading, while the use edge is generally acute, exhibiting minimal use grinding and edge rounding. It displays notches on both sides, and a less well-defined groove on the dorsal surface. One of the lateral grooves has been both pecked and heavily abraded, while the other has been only minimally abraded, but also pecked. It measures 8.17 cm long by 6.72 to 7.05 cm wide and 3.97 cm thick. At the lateral grooves it measures only 5.97 cm wide.

Miscellaneous Ground Stone Objects

This category is made up of four artifacts which do not particularly fit into the previously defined categories. The first is an oddly shaped, small piece of sandstone recovered from the F2 midden at Pit Structure 2 in CC-20, at a depth of 90 to 110 cm.

The stone can be held in the fingers and it displays a natural concavity, which could have been used as a shaft smoother for wood and/or bone artifacts. The interior surface of the groove appears to be abraded. It measures 3.27 cm long by 3.61 cm wide, while the groove measures a maximum of 2.1 cm wide and 0.6 cm deep.

The next artifact is a circular to ovate disk composed of a soft and chalky carbonate. The edges are tapered and the dorsal surface is convex. The ventral surface is generally flat, but naturally irregular. It measures 7.91 cm long by 6.95 cm wide and a maximum of 1.93 cm thick. It was recovered from F4 fill.

The following artifact is a rounded rectangular piece of modified stone, apparently a pendant blank. It is slightly tapered at one end, and the entire stone has been smoothly ground, while the edges are flat to slightly tapered. It measures 1.1 cm long by a maximum of 0.77 cm wide and 0.12 cm thick. It was recovered from Pit Structure 2 (F2 midden) at CC19.

The final artifact in this category is an unmodified piece of coarse, lumpy sandstone, which looks like a small rounded maul. It measures 5.48 cm long by 3.81 cm to 3.86 cm in diameter. A natural seam encircles the artifact forming two spherical ends. It exhibits a limited amount of surface abrasion, and one end may display some sporadic evidence of pounding. It was recovered from a depth of 100 to 120 cm in Grid E-17.

Ground Stone Fragments

A total of 136 ground stone fragments, all but two composed of sandstone, were identified from this site. The exceptions include one made of quartzite and one composed of petrified wood. In general, these are tabular pieces of stone recovered from a variety of stratigraphic situations (Provenience Tables).

The majority of the fragments, 55 (44%), consist of tabular pieces of unifacially ground stone, including the petrified wood example. Three of the sandstone fragments may be portions of modified disks. Twenty-seven artifacts, (12.5%), consist of bifacially ground tabular fragments, exhibiting one surface more smoothly abraded then the other. Twenty-two, 16.1%, are stone fragments exhibiting some evidence of abrasion, and 19, (14%), are tabular, bifacially ground fragments. The remaining thirteen fragments include three bifacially ground stone fragments, displaying one more smoothly abraded surface; two tabular ground fragments; two unifacially ground pebbles; and two pecked and bifacially ground fragments. Lastly, one each of the following fragments were observed: a ground tapered concretion; a ground tabular fragment; a unifacially ground; square piece of sandstone; and a unifacially abraded quartzite cobble fragment.

Additional Rocks and Minerals

Several of objects were found that seem to have been brought to the site and although they exhibit no evidence of physical manipulation, they apparently had some cultural significance. These objects include a few natural sandstone concretions, iron ore fragments, possible pigment stones, and three gypsum nodules.

One palm-size, natural gypsum nodule was recovered from Pit Structure 4 fill. Two smaller pieces were also recovered from a depth of 200 to 220 cm in Pit Structure 1 fill. In addition, two cylindrical, natural sandstone concretions were found in the 160 to 180 cm level in Pit Structure 1. An ovate sandstone concretion, measuring 3.84 cm long by 3.34 cm in diameter was recovered from Grid E-17 in the 100 to 120 cm level. One piece of poorly cemented, coarse grained, deep red sandstone appears to be a pigment source. It measures 1.9 cm by 1.74 cm in diameter, and it was recovered from a depth of 90 to 110 cm in the Stratum 2 midden at Pit Structure 2 within grid CC-20.

One palm-size, tabular fragment of iron ore was recovered from grid 16 fill above Pit Structure 1. Two iron ore fragments, one containing an interior, silicified, deep red hematite deposit, were recovered from the 60 to 70 cm depth in A-17. Work in Pit Structure 1 yielded one piece of iron ore nodule shatter with an interior deep-red jasper formation. Six pieces of iron ore, which originally appear to have been one rock, were recovered from a depth of 220 to 240 cm in Pit Structure 1 fill. Lastly, one piece of a pink-red mineral, similar in composition to hematite deposits found contained within iron ore nodules, was recovered from F35 in association with Pit Structure 1. It measures 1.88 cm by 1.6 cm in diameter.

SUMMARY

A total of 449 pieces of ground stone were recovered during the excavation of this site. Seventy percent of these artifacts have been identified as tools, with the remaining 30% consisting of ground stone fragments. The dominant utilized material is sandstone, which makes up 57% of the collection, followed by quartzite (38%), type C1 chert (3%), basalt (1%), and other types of chert (1%). Sandstone, quartzite and type C1 chert are all locally available materials, accounting for their dominance in the collection. Sandstone is generally the favored material for food grinding implements, such as manos, metates and grinding slabs. Quartzite would have been the most immediately available raw material, as it is present in the alluvial deposits within the canyon. It has been primarily used for hand tools such as cobble edge abraders, flake edge abraders, and abrading stones. Chert is generally not suitable for the production of ground stone artifacts, and only a few minor pieces are in the collection.

Only fourteen grinding platforms, primarily fragments, were identified within the collection. In general, use-basin fragments dominate this tool type, indicating the presence of food preparation activities at this site. The collection reflects an obvious preference for trough/basin metates over flat preparation platforms.

The majority of the ground stone artifacts are hand stones, including, in decreasing order of frequency, cobble abraders (30%), manos (16%), abrading stones (12%), and flake abraders (11%). Manos are, by definition, primarily associated with food preparation activities, while the three other dominant tool types are associated with a variety of differing functions, as well as possible food grinding activities. Additional uses include the preparation of vegetal materials for basketry and twining, ceramic production, pigment preparation, clay floor treatments, tool production, and hide preparation. In general, it appears that two-hand manos were more prevalent in the collection, making up five of the eight complete specimens and four of the fragments, where original size could be determined. The dominant hand tool, the cobble abrader, may have been used for hide preparation as they exhibit extensive abrasion on the lower distal, surface, apparently from contact with softer materials.

The majority of the ground stone artifacts were recovered from fill contexts on the site; although, a limited number of hand tools were found in association with structure floor contexts. Cobble abraders were most commonly found in floor associations, including four from Pit Structure 1, four from lower fill contexts in Residential Room 1, one on the lower floor of Storage Room 1, one from the Pit Structure 3 bench, and one from the floor of Pit Structure 2. In addition, two abrading stones were found on the floor of Pit Structure 1, and flake abraders were also recovered from structure floor associations. All three manos found in floor contexts are two-hand varieties, one from the upper surface of Storage Room 1 and two in contact with the Pit Structure 3 bench. In general, there are a limited number of ground stone artifacts in secure structural proveniences, but the evidence does suggest that Pit Structure 1, Residential Room 1, Storage Room 1, Pit Structure 3 and Pit Structure 2 were structures in which domestic activities occurred. The bench in Pit Structure 3, in particular, appears to have been an area where ground stone tools were stored.

In sum, the ground stone tools recovered from 42Ka3976 are similar to assemblages found at other Virgin Anasazi sites (Walling et al. 1986; Walling and Thompson 1986, 1988; Dalley and McFadden 1988). The presence of a wide variety of tools implies that a full range of domestic activities were occurring here; a rather limited range of material indicates that locally available resources were heavily utilized. The predominance of cobble abraders in the tool collection, 30% of the total tool count, suggests that they are associated with a principal activity at this site. At this time, the exact function of this tool type is not fully understood, but they have apparently been used in the processing of softer materials of an organic nature, or malleable inorganic products, such as clay.

Chapter 9
Faunal Remains
by
Lis T. Nauta

A total of 869 complete and fragmentary skeletal elements was recovered from the excavations at 42KA3976. The assemblage was analyzed using the comparative faunal collections at the Museum of Peoples and Cultures at Brigham Young University. Data gathered during the analysis include taxon and element identification, presence of burning and butchering marks, and provenience. The number of specimens identified (NISP) to at least an order level is 329 (Table 9.1). The remaining 540 elements and fragments could only be identified to the order and size class levels (Table 9.2). The remains represent mammals, birds, and one reptile. Both NISP and Minimum Number of Individuals (MNI) calculations are used in this discussion. While NISP is a convenient way to show numbers of skeletal elements and fragments that could be identified, MNI might better show the actual number of individual animals represented by the identifiable remains. A combination of the two is generally regarded as necessary to more accurately reflect a faunal assemblage (Klein and Cruz-Uribe 1984).

Mammals comprise 95.4 percent of the NISP, with birds and reptiles making up the balance (Table 9.1). The dominant mammal by NISP is *Ovis canadensis*, which makes up 23.1 percent of the total identified mammals, with other probable food source animals including *Lepus* sp., *Antilocapra americana*, *Sylvilagus* sp., *Odocoileus hemionous*, and *Cervus elaphus* listed in descending order of NISP percentage. The MNI calculations suggest roughly equal importance between *Antilocapra*, *Odocoileus*, and *Ovis*, with perhaps significant overall reliance on *Lepus* and *Sylvilagus*. The identified faunal distribution by NISP and percent NISP, identifiable only to the level of order is shown in Table 9.2. The identifications are as follows:

MAMMALS

Class – Mammalia

Small Artiodactyla – Deer, Mountain Sheep, Pronghorn

Skeletal materials in this category were too fragmentary to be positively identified other than to the small artiodactyl category. Material: 1 parietal, 1 molar, 2 rib, 1 scapula, 1 sternabrae, 1 humerus, 1 proximal radius, 1 distal radius, 1 pelvis, 3 femurs, 1 patella, 1 tibia, 1 cuneiform, 1 carpal, 3 proximal metacarpals, 2 medial metacarpals, 1 distal metacarpal, 3 proximal metapodials, 6 medial metapodials, 1 tarsal, 1 proximal metatarsal, 3 medial metatarsals, 4 first phalanges, 1 second phalanx, 3 third phalanges, 6 sesamoids, 1 long bone fragment,: 63 specimens. MNI: 2, based on femurs.

Family Cervidae – Deer, Elk

Cervus elaphus – Elk

Material: 2 ribs: 2 specimens. MNI: 1

Remarks: Elk is generally rare in archaeological assemblages across Utah, but not absent. The recovery of two elk rib fragments is a bit surprising, although the uplands adjacent to the site could

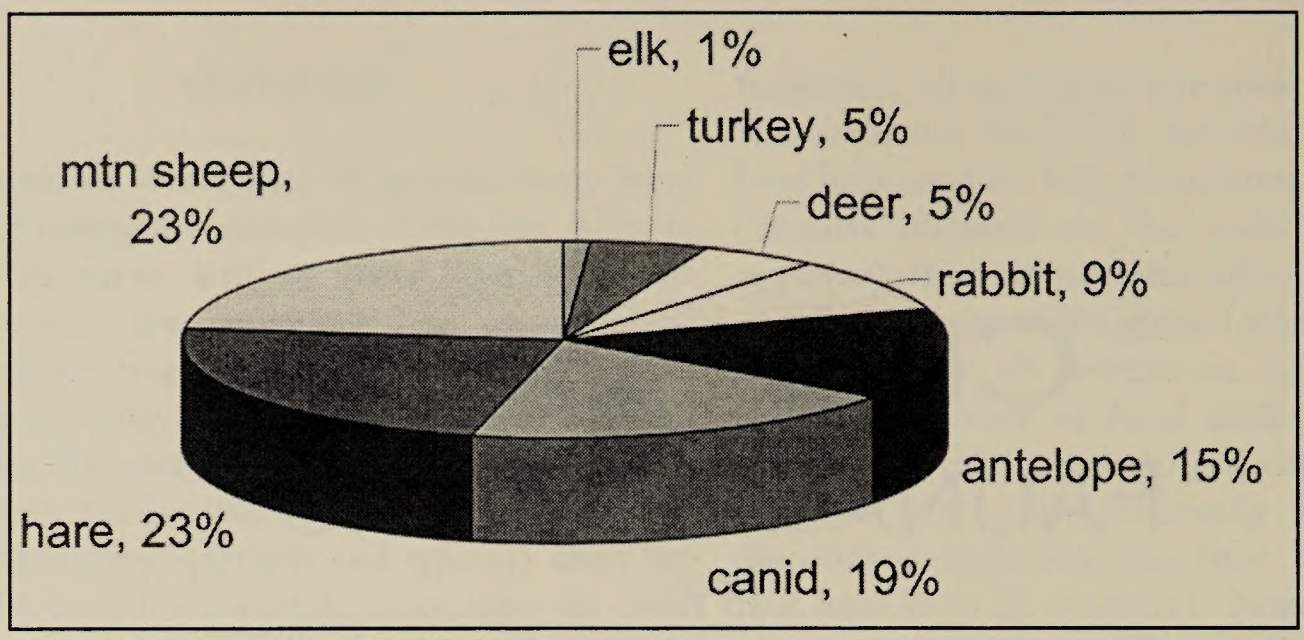


Figure 9.1. Fauna from the Arroyo site.

	NISP	%NISP	MNI
Mammal			
Antilocapra americana	50	15.2%	3
Cervus elaphus	2	0.6%	1
Odocoileus hemiouous	15	4.6%	2
Ovis canadensis	76	23.1%	3
Canis sp.	63	19.1%	2
Lepus sp.	74	22.5%	7
Sylvilagus sp.	31	9.4%	8
Erethizon dorsatum	1	0.3%	1
Spermophilus sp.	2	0.6%	3
Bird			
Meleagris gallopavo	15	4.6%	1
Total	329	100.0%	31

Table 9.1. Number of identified specimens (NISP), percent NISP, and minimum number of individuals (MNI) for skeletal elements identified to the species level.

	COUNT	PERCENT
Large Mammal	274	50.7%
Small Artiodactyl	63	11.7%
Medium Mammal	20	3.7%
Small Mammal	80	14.8%
Micro Mammal	3	0.6%
Unidentified Mammal	57	10.6%
Large Bird	28	5.2%
Medium Bird	12	2.2%
Unidentified Bird	2	0.4%
Small Reptile	1	0.2%
Total	540	100.0%

Table 9.2. The NISP count and percent of the skeletal elements identified to only the order level.

have been appropriate habitat in the past. Elk are occasionally seen in the general area today.

Odocoileus hemionus – Mule Deer

Material: 1 axis, 1 scapula, 2 right pelves, 1 radius, 1 calcaneus, 1 astragalus,1 distal metatarsal, 4 first phalanges, 1 second phalanx, 2 third phalanges: 15 specimens. MNI: 2, based on pelves.

Family Bovidae – Cow, Bison, Mountain Sheep

Ovis canadensis – Mountain Sheep

Material: 2 horn cores, 1 mandible, 1 maxilla, 1 atlas, 1 axis, 1 cervical vertebrae, 1 scapula, 2 left humeri, 1 right humeri, 2 left radii, 1 right radius, 1 proximal ulna, 1 carpal, 7 proximal metacarpals, 5 distal metacarpals, 5 astragali, 2 right calcaneum, 3 left calcaneum, 3 navicle cuboids, 1 tarsal, 1 proximal metatarsal, 1 metatarsal, 22 first phalanges, 4 second phalanges, 6 third phalanges: 76 specimens. MNI: 3

Family Antilocapridae – Pronghorn

Antilocapra americanus- Pronghorn

Material: 2 sternebrae, 1 scapula, 3 ribs, 1 proximal ulna, 1 radius, 1 distal metacarpal, 5 astragali, 3 calcaneum, 2 navicle cuboids, 4 proximal metatarsals, 18 first phalanges, 4 second phalanges, 4 third phalanges, 1 long bone fragment: 50 specimens. MNI: 3, based on phalanges and calcaneum.

Family Canidae – Wolf, Dog, Fox, Coyote

Canis sp. – wolf, domestic dog

Material: 2 skulls, 1 left mandible, 1 right mandible, 7 cervical vertebrae, 3 thoracic vertebrae, 9 lumbar vertebrae, 1 left pelvis, 1 right pelvis, 11 proximal ribs, 3 distal ribs, 2 sternabrae, 1 scapula, 1 left clavicle, 1 right clavicle, 1 left humerus, 1 right humerus, 1 left radius, 1 right radius, 1 proximal ulna, 1 metacarpal, 1 left femur, 1 right femur, 1 left tibia, 1 right tibia, 1 left fibula, 1 right fibula, 2 astragali, 2 calcanei, 3 metatarsals: 63 specimens. MNI: 2, based on skulls.

Family Erethizontidae – Porcupine

Erethizon dorsatum – Porcupine

Material: 1 scapula: 1 specimen. MNI: 1

Family Sciuridae – Squirrels

Spermophilus sp. – Ground squirrel, Rock squirrel

Material: 3 mandibles, 1 scapula: 4 specimens. MNI: 3, based on mandibles

Family Leporidae – Rabbit and Hare

Lepus sp. – Jackrabbit, Hare

Material: 1 premaxilla, 6 mandibles, 1 molar, 1 thoracic vertebrae, 5 left pelvis, 3 right pelves, 2 ribs, 4 right scapulae, 4 left scapulae, 1 distal humeri, 2 left radii, 4 right radii, 3 right ulnas, 1 left ulna, 1 metacarpal, 1 right femur, 2 left femurs, 1 femur, 7 right tibiae, 3 left tibiae, 1 tibia, 2 astragali, 2 calcaneum, 1 proximal metatarsal, 4 distal metatarsals, 10 metatarsals, 1 first phalanx: 74 specimens. MNI: 7, based on right tibiae

Sylvilagus sp. – Cottontail, Rabbit

Material: 1 malar, 2 left mandibles, 4 right mandibles, 1 pelvis, 2 scapulae, 1 humerus, 1 radius, 1 ulna, 1 left femur, 1 right femur, 4 left tibiae, 8 right tibiae, 1 distal metatarsal, 3 metatarsals: 31 specimens. MNI: 8, based on tibiae

The 497 unidentified mammalian bones (Table 9.2) include 274 large mammals, 63 unidentified small artiodactyla, 20 medium mammals, 80 small mammals, 3 micro mammals, and 57 mammals of an unidentified size.

BIRDS

Class – Aves

Family Meleagridae – Turkey

Meleagris gallopavo – Wild Turkey

Material: 1 skull, 1 mandible, 1 atlas, 1 axis, 1 cervical vertebrae, 2 quadrates, 1 sternum, 1 synsacrum, 1 sacral vertebrae, 1 humerus, 1 femur, 1 tibia, 1 left fibula, 1 right fibula: 15 specimens. MNI: 1

Remarks: The only identifiable bird bones belong to turkey. A minimum of one turkey is represented. Many of the elements are present which may indicate the turkey was articulated at the time of deposition. This is one of the northernmost occurrences of turkey west of the Colorado River.

In addition, there were 28 unidentified large bird bones, 12 medium bird and 2 bird bones of an unidentified size. The unidentified large bird bones may also be turkey, which, if so, would increase the importance of this bird to the Arroyo site inhabitants.

REPTILE

Only one reptile bone was recovered and belongs to a small lizard. This bone is probably a result of natural deposition.

Class – Reptilia

Order Lacertalia – lizards

Material: 1 pelvis: 1 specimen. MNI: 1

CULTURAL MODIFICATION

Burned bone is often thought to be associated with the human use of bone including consumption. Ninety (10.3%) of the bones from 42KA3976 were burned. They include: 39 unidentified large mammal, 1 unidentified medium mammal, 4 unidentified small mammal, 3 unidentified mammal, 16 small artiodactyla, 2 mule deer, 10 pronghorn, 9 mountain sheep, 5 jack rabbits, 1 turkey.

Cut marks were not common but were noted on several elements. Specifically, cut marks were noted on small artiodactyl elements, including a distal metacarpal and distal metapodial. Cut marks were also present on a mountain sheep first phalanx, the base of a horn core, as well as on a pronghorn astragalus. Binford (1981) notes that cut marks on the horn core are probably due to skinning and the cut marks found on the lower leg bones could be a result of skinning, filleting or dismemberment. Most importantly, the cut marks indicate that butchering occurred at the site, which in turn suggests that, at least in some cases, entire carcasses were brought to the site rather than being butchered in the field. Given the high transport cost of large animals such as mountain sheep, this may indicate that animals were being hunted close to the Arroyo site.

DISCUSSION AND CONCLUSIONS

The analysis of the unmodified faunal remains from the Arroyo site has provided important and rare insights into Puebloan subsistence patterns. It is clear that mammals, including small artiodactyls and lagomorphs, were important food items to the site inhabitants. The most abundant artiodactyl in the faunal assemblage by NISP is mountain sheep (NISP = 76), followed by antelope (NISP = 50), and deer (NISP = 15). Additional small artiodactyl bones (n = 63) are present and, when combined with those identified to species, suggest that large game was very important to the inhabitants of the Arroyo site. It appears that small artiodactyls were both butchered (evidenced by cut marks) and consumed (evidenced by burning) at the site.

Leporids were not as abundant as the larger game by NISP, but the minimum numbers of individuals were higher with at least seven hares (*Lepus* sp.) and eight cottontail rabbits (*Sylvilagus* sp.) represented in the assemblage. Although the sample size from this site might be considered small, the MNI figures suggest that while small artiodactyls were probably an important food source, leporids (rabbits and hares) were a more common addition to the diet. A single deer, mountain sheep, or pronghorn would provide an impressive amount of meat protein per animal, but the smaller and more common rabbits and hares may have contributed an important, individually smaller, but more predictable source of protein.

The abundance of mountain sheep and pronghorn in the Arroyo assemblage contrasts with small artiodactyl assemblages from the Dead Raven (Walling and Thompson 2004), Park Wash (Ahlstrom 2000) and Kanab (Nickens and Kvamme 1981) sites, where mule deer tended to dominate. Pronghorn was present only at the Kanab site. The presence of two elk (*Cervus elaphus*) ribs is intriguing since, as noted above, elk tend to be rare in sites throughout Utah (Janetski 1997). A single elk bone is also reported by Aikens (1965:39) from Bonanza Dune in Johnson Canyon. Taken as a whole, the faunal remains from Anasazi sites in and adjacent to Grand Staircase-Escalante National Monument suggest hunters had access to significant numbers of large game animals, including elk, mountain sheep, mule deer, and pronghorn. While the importance of particular species may have varied over time and space, all appear to have been important sources of food and raw material during the Puebloan period.

At least two canids are represented in the Arroyo assemblage. Nearly all of these remains came from the fill of Pit Structure 1, with only a skull found in Pit Structure 2. Most likely the canid bones from Pit Structure 1 are from the same individual. None of the bones are burned or cut, which suggests

that these individuals were domestic dogs and were purposefully placed in the structure fill either as burials or simply to dispose of the carcass. Canids are rarely reported present on Anasazi sites in the area; e.g, none were reported at the Dead Raven (Walling and Thompson 2004), Kanab (Nickens and Kvamme 1981) or Park Wash sites (Ahlstrom 2000), although they are rather common on Fremont sites and various Anasazi sites elsewhere in Utah (see Lupo and Janetski 1994, Emslie 1978 for summaries). (Editor's note: a largely articulated canid was eventually recovered from the midden at the Kanab site after Emslie's report was published).

Ground squirrels (*Spermophilus* sp.) and porcupine (*Erethizon dorsatum*) also appear in the faunal assemblage, but it is unclear if these were food, materials sources or natural intrusions into the site. The preparation for consumption of rodents was documented at the nearby Park Wash site (Chapin-Pyritz 2000), but there is no direct indication that ground squirrels were a food source at 42Ka3976. However, unidentified burned small mammal bones were recovered. Due to the burrowing habits of ground squirrels, their remains may well be a natural intrusion into the site. The single porcupine element may also be intrusive, although porcupines generally prefer wooded environments and are a less common occurrence in an open valley setting. In open settings porcupines tend to prefer riparian zones, which may be an indicator of the Park Wash environment during P-II times, especially when viewed in conjunction with the presence of *Typha* (cattail) pollen recovered at this site.

Turkey, possibly domesticated, is the only identified bird from the Arroyo site. Although a humerus was burned, suggesting the bird was cooked for consumption, the relative completeness of the skeleton and its location on the floor of Pit Structure 2 seems to argue against this (see Descriptive Summary above; see also discussion by Olsen 1968:107, who suggests turkeys were raised for feathers more so than food items). The find is reminiscent of the recovery of three partially articulated turkey skeletons at the Kanab site, which suggested that the birds were intentionally buried (Emslie 1981). Turkey is common in Pueblo II and III sites to the east (Thompson 1990, Munroe 1994) and is considered by some (Thompson 1990) to have been used as food as well as feathers for decoration and robes. While Olsen (1968:107) states that domestication occurred as early as A.D. 500, its importance as a food item may not have began until Pueblo II times (McKusick 1985).

In summary, the faunal remains from the Arroyo site are a significant data set that adds substantially to a small but increasing number of archaeofaunal collections from southern Utah. The excellent preservation of bone on prehistoric sites on the eastern Grand Staircase is encouraging, not only for contrasting and comparing prehistoric diet, but also for contributing to a more dynamic perspective on the natural environment.

MODIFIED BONE

A total of eighteen bone tool or tool fragments were recovered during the Arroyo site excavations. Following Dalley (1970), they have been classified into four descriptive categories (Table 9.3). The categories are based on the orientation of the bone and the degree of modification the butt end has received. Tip shape and degree of taper are also important observations that probably relate to function. With the exception of what appears to be a bird bone (FS-103), all are fragments of metapodial bones from unidentified species of Artiodactyla.

Wear and polish on most specimens indicate these tools were intensively used. Variability of size, shape, and durability suggests a variety of uses, including leather working and basket weaving (Dalley 1970). The majority were recovered from midden contexts, suggesting that they were easily made and considered disposable. Only a single specimen was found in a floor context (FS-351).

The closest comparative collections for bone awls come from the nearby Park Wash site (Alstrom 2000) and the Dead Raven site in Johnson Canyon (Walling and Thompson 2004). Both of these sites represent BMIII/Pueblo I or Early PII periods that predate the Arroyo occupation. Splitting the distal end of a deer or antelope metapodial (Type II) and using a ground and shaped bone splinter was the preferred technique of manufacture at Arroyo. Awls from Dead Raven and Park Wash retained the split head (Type I) more frequently than late sites however they did display both types. It is not clear whether the change is frequency from Type I to Type II awls

FS#	Provenience		Figure	Description	Type
	Feature	Context			
103	A17 Grid	60-80cm	O	Needle, Bird bone	IV
034	F16	100-120cm	A	Bone Awl, metapodial, w/head	I
034	F16	100-120cm	P	Bone Awl Frag.	V
328	F17	Fill	K	Bone Awl, no head	III
033	Pit Structure 1	120-140cm	R	Bone Awl Frag.	V
074	Pit Structure 1	120-140cm	C	Bone Awl, no head	II
100	Pit Structure 1	120-140cm	E	Bone Awl, no head	II
100	Pit Structure 1	120-140cm	F	Split Long Bone Frag.	-
133	Pit Structure 1	140-160cm	Q	Bone Needle Frag.	V
133	Pit Structure 1	140-160cm	D	Bone Awl, no head	II
310	Pit Structure 1	240-260cm	I	Split Long Bone	III
341	Pit Structure 1	10-30cm above floor	M	Bone Awl Frag.	III
351	Pit Structure 1	Floor Contact	B	Bone Awl, no head	II
355	Pit Structure 1	Spoil	H	Bone Awl, no head	III
355	Pit Structure 1	Spoil	J	Bone Awl Frag.	III
065	Pit Structure 2	145-155cm	N	Bone Needle	III
087	Pit Structure 2	130-145cm	G	Bone Awl Frag.	III
109	Pit Structure 3	Bench Fill	L	Bone Needle	III

Table 9.3. Modified bone proveniences.

over time indicates a change in function, stylistic preference, or some other cause.

Casual observation on the ubiquity of bone awls, of whatever type, on excavated sites from all periods in the Virgin culture area suggests that, whether a big game source of bone was available or not, and whatever their function may have been, awls were an important part of the tool kit throughout the region.

Description of Awl Types

Type I, Head of Bone Split Awls

One example of this type was recovered (Fig. 9.12A). Split and ground metapodial with proximal end used as the butt. Use polish apparent. Length is 7.5cm

Type II, Distal End of Bone Split Awls

Four examples (Fig. 9.2B-E) and one partially worked fragment (Fig. 9.2F) were recovered. Length varies from 8 cm to 15 cm. Tips range from very sharp to slightly blunted. The angle of the tip varies considerably.

Type III, Splinter Awls

There are four examples of this type (Fig. 9.2G-M). These types tend to be thin and fragile with sharper angles on the tip. Examples have both ground butt ends as well as broken ends. Length varies from 6 cm to 13 cm.

Type IV, Bird Bone Awls

A single example occurred on the site. The length of the awl is 5 cm. (Fig. 9.2O)

Type V, Tip Fragments

Three examples of this type were represented at the site. (Fig. 9.2P-R)

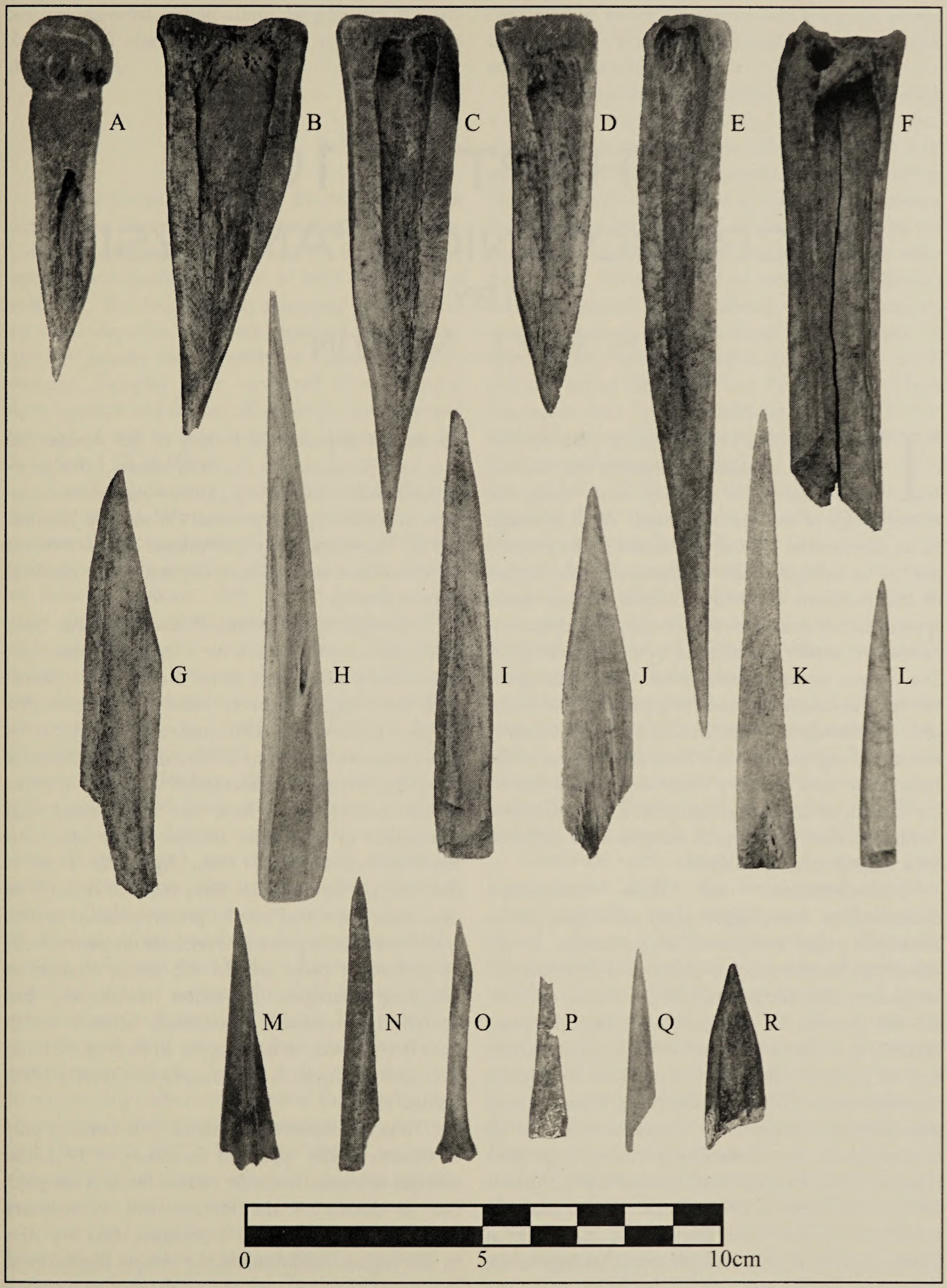


Figure 9.2. Modified bone awls and needles.

Chapter 10
Macrobotanical Analysis
by
Steve L. Martin

The Arroyo site (42Ka3976) is a late Pueblo II Virgin Anasazi habitation site located in central Kane County, Utah along the western edge of the Kitchen Corral Wash drainage. At an elevation of 1750 m. it is found in the pinyon-juniper woodlands that characterize this region of the northern Colorado Plateau. Buried under approximately one meter of alluvium, the site was not discovered until it was bisected by an arroyo in 1995. The unique circumstances under which this open-air site was discovered and its apparent rapid burial after abandonment offered an excellent opportunity to recover organic remains. Therefore, as part of the emergency data recovery excavation conducted by the Bureau of Land Management, Kanab Resource Area, a number of sediment samples were collected for a macrobotanical analysis.

Macrobotanicals are those carbonized, desiccated, or waterlogged plant parts that can be identified under low-power magnification. In the American Southwest, only carbonized plant remains are preserved in the deposits of most open-air sites. In the process of carbonization, organic plant material is reduced to about 50% elemental carbon and as such is essentially impervious to organic decomposition (Meyer 1980:403). Uncarbonized plant remains recovered from the deposits of open-air sites represent contamination by modern vegetation (Gasser 1982; Lopinot and Brussell 1982; Minnis 1978, 1981; Keepax 1977). Such remains are only considered to have been deposited as the result of human activity in very arid, protected settings in the American Southwest, such as dry caves. Although the unique depositional history of the Arroyo site may have protected the site from looters, other post-depositional processes (e.g., burrowing rodents) may have introduced plant material (Wood and Johnson 1978). Therefore, only carbonized plant remains are considered to have been deposited as a result of human activity.

Although macrobotanical analyses have been conducted at other open-air Virgin Anasazi sites, most have yielded little to no carbonized material, with the meager recovery often being attributed to poor preservation. Unfortunately, a majority of these analyses have been confounded by inadequate sampling strategies, unorthodox flotation systems whose recovery rates have not been tested, and incomplete or inaccurate analysis of the recovered remains (see Martin 1996b, Appendix I for a discussion). These studies have made it difficult to determine the actual level of preservation in various contexts and have prevented accurate reconstructions of prehistoric plant use. In this study, established sampling strategies, extraction techniques, and analytical procedures (described below), which have been proven to be effective in dealing with the encountered deposits, were employed (Martin 1992; Valdez 1993).

Thus, the objectives of this analysis were not only to document the type and frequency of botanical remains recovered from the various features sampled, but to determine the effectiveness of recovery strategies and extraction techniques that are new to this region. Additionally, the unique depositional history of the site, amiable to the preservation of

organic material, would allow the gauging of post-depositional change occurring at open-air Virgin Anasazi sites.

METHODS

The author and members of the excavation team carried out sampling of archaeological deposits. Unless constrained by context or feature, every attempt was made to obtain at least two liters of sediment. The focus of the sampling strategy was on those deposits that were expected to yield the greatest density and diversity of carbonized plant remains. Samples were recovered from hearths, floor contacts and feature fill (from pit structure and burials), as well as from a column sample from Pit Structure 1 fill (midden).

Flotation is the most common process whereby macrobotanical remains are concentrated and recovered from archaeological deposits. Although there is variation in the construction and operation of flotation systems, they are all based on the same principle: when sediment recovered from archaeological sites is placed in water, the dense matter sinks and buoyant plant remains float and are recovered. Sediment samples from the Arroyo site were processed in a mechanical flotation device following Watson's (1976) design and processing procedure. The flotation device consists of a 55 gallon water-filled drum with an insert screen of 1.5 mm mesh. Sediment samples of known volume were slowly poured into the partially submerged insert screen. Low density carbonized botanical remains (light fraction) float to the surface and are directed out of the drum, via a sluiceway, into chiffon netting (0.02 mm mesh). High density carbonized botanical remains are brought to the surface by the action of water agitation and stirring. This procedure is performed until no carbonized plant material is seen flowing into the netting. A siphon is then used to remove any carbonized material that has become waterlogged and remains submerged (Gumerman and Umemoto 1987). Once the siphon process is completed, the netting is hung to dry and the material remaining in the insert screen (heavy fraction) is set out to dry and saved for future analysis. All light and heavy fractions were examined for the presence of carbonized botanical material. The recovery rate of the flotation device has been tested using the poppy seed method (Wagner 1982) and consistently yields recovery rates ≥90%.

When dry, the light fraction was sifted through a series of nested sieves (2.00, 1.00, and 0.50 mm) yielding three size fractions (>2.00 mm, 2.00-1.00 mm, and 1.00-0.50 mm) in preparation for sorting. The light fraction is divided as such for two reasons. It is easier to sort material of similar size given the shallow depth of field of the incident light binocular microscope (10-40x) used to retrieve and identify macrobotanicals. It also allows one to selectively remove distinct materials from each fraction. In this analysis, carbonized wood, *Zea mays* L. (maize) cob and kernel fragments, and *Pinus* sp. (pine) bark fragments were removed only from the >2.00 mm fraction and weighed. Due to their size and shape, pine and *Juniperus* sp. (juniper) leaves are rarely found in the >2.00 mm fraction. These items were removed from the >2.00 mm and 2.00-1.00 mm fractions and weighed. All other carbonized seeds, nut and fruit fragments, and other plant parts were removed from all of the sieves (>2.0 mm, 2.00-1.00 mm and 1.00-0.5 mm fractions) and counted or weighed. Material <0.5 mm in size is considered residue and was not analyzed.

Finally, the recovered carbonized plant remains were identified though the use of seed manuals (e.g., Delorit 1970; Martin and Barkley 1961; Young and Young 1992), comparative seed collections located in the Cotsen Institute of Archaeology at UCLA, and field collections in the possession of the author.

Seeds are rarely identified to the species level because seeds within the same genus are often morphologically very similar and carbonization often distorts seeds, obscuring diagnostic characteristics. There were a number of seeds that could not be identified to the genus level and, based on morphology, were placed in the Asteraceae (sunflower), Brassicaceae (mustard), Lamiaceae (mint), Malvaceae (mallow), Poaceae (grass), or Portulacaceae (purslane) families. The only unknown family type to occur in multiple samples was Poaceae type 1, which is small (1.5-2.0 x 0.5 mm), narrowly elliptic, and possesses longitudinal ridges along its surface. The category Cheno-Ams includes a number of species found in the Chenopodiaceae and Amaranthaceae families whose lenticular seeds contain a central endosperm around which the embryo

curves (e.g., *Amaranthus*, *Atriplex*, *Chenopodium*). Seeds placed in this category lack diagnostic seed coats upon which identifications to the family or genus level are made. There were also several other seeds that the author could not identify; these are designated as unknown types. Only one, unknown type 1, occurred in multiple samples. Unknown type 1 is small (2.0 x 1.5 mm), obovate, and possesses a wrinkled surface. Seeds that were too distorted or fragmented to classify to even the family level were placed in the unidentifiable seeds category. Botanical material that lacked any diagnostic characteristics and could not be positively identified to a known taxon was placed in the amorphous category. This material is typically very porous, possesses minimal vessel structure, and lacks a distinctive shape. In many instances, the amorphous material appeared to be maize endosperm. Parallel-sided specimens are unidentifiable seed coat or nutshell fragments whose inner surface is parallel to the outer surface. Any identification that carries some uncertainty is indicated as cf. The taxonomy used here follows Welsh et al. (1993).

RESULTS

A total of 40 sediment samples, comprising a total sediment volume of 78.7 liters (L), were recovered from five hearths (32.5 L) found in four structures, eight floor contacts (21.2 L) recovered from seven structures, the fill of three features (10.0 L), and seven column levels (15.0 L) from Pit Structure 1 fill (midden). This represents 23 discrete deposits which yielded 2,339 seeds (1,925 of which were identifiable to at least the family level), 680.53 g of unidentified wood charcoal, and 14.44 g of maize cob fragments (not including two intact cobs). Altogether, 20 identifiable genera in 16 families and at least 16 unidentifiable genera placed in 6 families were recovered (Table 10.1). Since the sediment volume of the flotation samples varied, density values (counts/L or g/L) for the recovered carbonized material were calculated so as to allow for comparisons across all samples. Individual sample seed densities ranged from 1.43 to 69.79 seeds/L (mean density 20.59 seeds/L), whereas the individual wood charcoal densities ranged from 0.34 to 43.40 g/L (mean density 6.34 g/L). None of the wood charcoal recovered was identified as part of this study. However, the presence of pine leaves (needles), ovulate cone fragments, and bark; juniper leaves (scales) and terminal buds; and the distinctive outer wood of Artemisia sp. (sagebrush) noted in a majority of the samples indicate the predominate fuel sources. Additionally, the large number of maize cupules in hearths and midden deposits indicate that corn cobs were used as a source of fuel as well. The results of the macrobotanical analysis of these sediment samples are presented in Tables 10.2-10.4.

Column Sample

A 140 cm, 7 level (20 cm sections) column sample was taken from the profile of Pit Structure 1 fill. The 0 cm mark was the habitation level datum in the profile and the column base ended just above the floor of the structure. The pit structure was unlined and filled with secondary refuse (midden). At the base of the arroyo, in the interior of the pit structure, was a square, slab lined hearth (Feature 14) that is discussed below. The results of the column sample analysis are presented in Table 10.2.

The lower levels of the column displayed a higher density and diversity of botanical remains, suggesting a better state of preservation for the lower deposits. Unidentifiable seeds and fragments aside, the column samples were dominated by chenopod seeds, most of which are probably *Chenopodium* spp. Maize, the second most dominate taxon, was the only domesticate present in the column. A considerable number of maize cupules were also recovered, as well as two intact cobs from the 60 to 80 cm level. The lowest level (120-140 cm) of the column yielded thirteen *Rhus* sp. (sumac) seeds, the first instance of their recovery in carbonized form from a Virgin Anasazi site. The specimens recovered compared favorably to *Rhus aromatica* Ait. (skunkbush) whose thin fleshed edible fruits were eaten and pliant branches used in basketry.

The presence of *Scripus* sp. (bulrush) may indicate that a permanent water source was near the site during the time of occupation. This semiaquatic genus is only found on the margins of lakes, ponds, and seeps; along springs and streams; and in marshlands. Today, the only permanent source of water near the site is a spring located approximately one kilometer to the northeast.

Scientific Name	Common Name	Part found	Part eaten[a]
Pinaceae	pine family		
Pinus sp.	pinyon pine	nutshell, leaf, bark	nut
Cupressaceae	cypress family		
Juniperus sp.	juniper	seed, leaf	fruit
Chenopodiaceae	goosefoot family		
Chenopodium spp.	goosefoot	seed	seed, leaf
Suaeda sp.	seepweed	seed	leaf
Amaranthaceae	amaranth family		
Amaranthus sp.	pigweed	seed	seed, leaf
Portulacaceae	purslane family		
Portulaca sp.	purslane	seed	seed, stem, leaf
Malvaceae	mallow family		
Sphaeralcea sp.	globemallow	seed	seed
Loasaceae	stickleaf family		
Mentzelia sp.	stickleaf	seed	seed
Capparaceae	caper family		
Cleome sp.	beeplant	seed	leaf
Brassicaceae	mustard family	seed	
Fabaceae	legume family		
Phaseolus vulgaris	common bean	seed	seed
Onagraceae	evening-primrose family		
Oenothera sp.	evening-primrose	seed	seed
Anacardiaceae	cashew family		
Rhus sp.	sumac	seed	seed, fruit
Solanaceae	potato family		
Physalis sp.	ground-cherry	seed	fruit
Lamiaceae	mint family	seed	
Asteraceae	sunflower family		
Artemisia sp.	sagebrush	seed	seed
Helianthus sp.	sunflower	seed	seed
Cyperaceae	sedge family		
Scripus sp.	bulrush	seed	rhizome
Poaceae	grass family		
Sporobolus sp.	dropseed	seed	seed
Stipa hymenoides	Indian rice grass	seed	seed
Zea mays	maize	seed (kernal), cob	seed
Agavaceae	agave family		
Yucca bacatta	datil yucca	seed	fruit

[a] This information is derived from ethnographic studies of local Paiute and various Pueblo Indian groups (Bye 1972; Castetter 1935; Cushing 1920; Fewkes 1986; Hough 1898; Kelly 1964; Newberry 1888; Whiting 1939; Yanovsky 1936).

Table 10.1. Identifiable taxa recovered from the Arroyo site flotation samples.

Rather than list all of the ethnographically documented uses for each taxon recovered, what Minnis (1989:544) has referred to as "the elaborate laundry list," suffice it to say that each taxon recovered from the column sample, as well as all other contexts considered in this study, have ethnographically reported uses by groups found in the region as food, fuel, building material, and in the manufacture of clothing and utensils (Bye 1972; Castetter 1935; Cushing 1920; Fewkes 1986; Hough 1898; Kelly 1964; Newberry 1888; Whiting 1939; Yanovsky 1936).

Hearths

Five hearths, found in four different structures, were sampled for macrobotanicals. The results of the analysis are presented in Table 10.3. In the floor of Pit Structure 1 was an intact, square, slab-lined hearth (Figs.3.17, 3.20) whose ash and charcoal content (21.3 L) was analyzed in its entirety. This feature yielded the highest seed diversity and density values with *Chenopodium* spp. predominating. The high diversity value is more than likely the result of the large sample size. The number of taxa present in an assemblage increases as a function of sample size, the larger the sample the greater the opportunity to recover rare taxa (Grayson 1984). In this instance, the rare taxa include juniper (seeds), the common bean (the only other domesticate recovered from the site), ground-cherry, and seepweed (found in riparian and palustrine habitats). The high seed density is due to the fact that the hearth was undisturbed and contained numerous burning episodes.

Hearth A, the uppermost of two superpositioned hearths (Fig.3.7) found in Residential Room 1 (a large habitation room in the room block), yielded the lowest wood charcoal density among the hearths, but an overall seed density comparable to that of the other hearths. This suggests that seed processing activities occurred in the vicinity of the hearth and that it was cleaned out prior to abandonment. The wood and seed densities of Hearth B, the lower hearth (Fig.3.7) in Residential Room 1, are similar to Hearth A except for a considerable amount of maize kernel fragments. Again, this suggests that seed processing activities (especially maize) occurred in the vicinity of the hearth and that it was cleaned out prior to abandonment.

The hearth in Pit Structure 3 yielded the highest wood charcoal density and relatively few seeds. Again, the low diversity is probably the result of the sample size, whereas the relatively low seed density most likely indicates that the contents of this hearth do not represent food (seed) processing activities. This notion is reinforced by the high wood charcoal density, low absolute counts of unidentifiable seeds, and the complete lack of maize kernels. The hearth (F32) found in Pit Structure 2, yielded a large number of maize kernel fragments, suggesting that maize processing occurred in this structure.

Floor Contacts

Eight sediment samples were collected from the floors of seven structures during excavation. Although the volumes of these samples vary widely, the seed diversity and density values (except for the lower floor of Storage Room 1) compare favorably with the other contexts sampled. The results of the analysis of the floor contact sediment samples are presented in Table 10.4.

There is nothing in the floor deposits from Pit Structure 1 (the fill and hearth of which are described above) that would distinguish it from the fill which lies above. As such, it can be considered a continuation of the column sample. The floor deposits of Residential Room 1 (a habitation room with two hearths, as described above) yielded carbonized beans and maize as well as the semiaquatic bulrush. The presence of a relatively large amount of maize kernels reinforces the notion that seed processing activities (especially maize) occurred in this structure.

Storage Room 1 (a paved storage room) had lower and upper levels that appear to represent two separate floor building events (Fig. 3.4). The lower floor (shown in Fig. 3.6 as the apparent west remnant of Residential Room 1) yielded a surprisingly large number of maize kernel fragments (so many that a weight instead of a count is given in Table 10.4) and a massive amount of amorphous material (the highest density reported) that appears to be maize endosperm. It should be noted that all of this material was removed only from the >2.00 mm fraction. The residue (<0.5 mm fraction) had an enormous amount of rounded, carbonized amorphous fragments that appear to be ground maize. The high wood charcoal density; high seed count, density, and diversity; and

Level (cm):	0-20	20-40	40-60	60-80	80-100	100-120	120-140
TYPE Volume (L):	2.0	2.0	2.1	2.2	2.0	2.2	2.5
SEEDS							
Amaranthus sp.		0.50(1)					0.40(1)
Artemisia sp.						0.45(1)	
Asteraceae cf.			0.48(1)				
Brassicaceae			0.48(1)	4.54(10)			
Chenopodium spp.						4.09(9)	2.80(7)
Cheno-Ams			0.95(2)	4.54(10)	3.50(7)	10.0(22)	6.00(15)
Cleome sp. cf.							0.40(1)
Mentzelia sp.	0.50(1)		0.48(1)	1.36(3)	6.50(13)	5.45(12)	1.20(3)
Oenothera sp.					1.50(3)		
Stipa hymenoides		0.50(1)					
Poaceae		1.50(3)		0.45(1)			
Portulaca sp.	0.50(1)						0.40(1)
Lamiaceae cf.						0.45(1)	
Rhus sp.							5.20(13)
Scripus sp.						0.45(1)	
Sphaeralcea sp. cf.	0.50(1)						0.80(2)
Yucca bacatta							2.00(5)
Zea mays							
kernel, whole		1.00(2)		2.27(5)		1.81(4)	0.40(1)
kernel, fragment			2.86(6)	6.36(14)	1.50(3)	0.45(1)	4.80(12)
Unknown type 1		1.00(2)	0.95(2)			0.45(1)	0.40(1)
Unknown type				0.45(1)		0.45(1)	0.80(2)
Unidentifiable seeds	0.50(1)	2.50(5)		22.72(50)	11.00(22)	8.64(19)	10.40(26)
Total[b]	2.00(4)	7.00(14)	6.19(13)	42.73(94)	24.00(48)	32.73(72)	36.00(90)
PLANT PARTS[c]							
Wood	0.34(0.68)	2.79(5.58)	3.08(6.48)	5.43(11.94)	5.51(11.02)	8.42(18.54)	8.46(21.16)
Zea mays:							
cob				2			
cupule	0.07(0.13)	0.05(0.09)	0.35(0.75)	0.39(0.85)	0.53(1.05)	0.53(1.17)	0.41(1.02)
glume			*(0.01)		*(<0.01/1)	*(<0.01/2)	*(0.01)
scutellum			*(<0.01/1)				*(<0.01/1)
Pinus sp.:							
leaf (needle)				*(0.01)	*(<0.01/1)	*(<0.01/1)	*(<0.01/2)
bark	0.01(0.03)	0.02(0.04)	0.11(0.23)	0.34(0.74)	0.06(0.12)	0.14(0.31)	0.03(0.09)

Table 10.2. Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the column sample from Pit Structure 1 fill.

nutshell			0.01(0.02)		*(<0.01/1)	0.01(0.02)	*(0.02)
Ovulate cone fragment				*(0.01)		0.16(0.36)	0.03(0.08)
Juniperus sp.:							
leaf (scale)				0.01(0.02)	*(<0.01/7)	*(0.002)	*(0.01)
terminal bud					*(<0.01/1)		
friut fragment							*(<0.01/)
Monocotyledon stem				*(0.01)			*(<0.01/10)
Parallel sided			*(0.01)				
Amorphous	*(0.02)	0.24(0.48)	0.04(0.08)	0.05(0.10)	0.03(0.05)	*(0.01)	*(0.01)
Unknown plant part	5.50(11)			10.45(23)		16.22(36)	8.00(20)

[a] Values in parentheses are raw counts and weights.
[b] Seed totals include unidentifiable seeds and fragments.
[c] Values in parentheses are weights (in grams) except unknown plant part(s). Weights < 0.01 g are followed by counts.
* Denotes weight densities < 0.01 g/L.

Table 10.2 (continued). Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the column sample from Pit Structure 1 fill.

the massive amounts of maize kernels and possible maize flour suggest that the structure was burned during occupation and then abandoned. Then, after some period of time, the floor deposits were capped with sterile sediments upon which the second floor was constructed. The upper floor of Storage Room 1 yielded few seeds and little wood charcoal, suggesting that it was cleaned prior to abandonment.

Pit Structures 3 and 4 (Figs. 2.29 and 3.30) are both small habitation pit structures that yielded moderate seed densities. The relatively high wood charcoal density and large amounts of pine leaves, bark, nutshell, and ovulate cone fragments suggests that the sediment sample from Pit Structure 4 not only represents a burning episode from the features hearth, but that all parts of the pine tree were used as a source of fuel. Pit Structure 3 yielded a large number of Poaceae type 1 seeds and a relatively large amount of maize cupules. The smallest floor contact sediment sample (0.4 L) came from the clean, sand fill of the floor pit (Fig.3.24) in Pit structure 3. As expected, this sample yielded only one seed and 0.05 grams of wood charcoal.

Feature Fill

The three fill samples were recovered from a pit structure exposed in profile and two burials. The sample volumes were constrained by the pit and burial contexts, and contamination from nearby midden was suspected for both burials. Feature fill typically represents secondary refuse and is often more diffuse than primary or off-site refuse areas. The results of the analysis of the feature fill sediment samples are presented in Table 10.5.

Feature 6 has been interpreted as a hearth (Chapter 3) in a probable pit structure that was exposed in the arroyo profile and only partially excavated (Fig.3.32). The appearance of the ashy fill of the pit was similar to that of the hearths of Pit Structures 3 and 4; however, the paucity of carbonized plant material indicates that the pit probably was not a hearth. Further investigation is required to determine if the recovered remains represent contamination from nearby midden deposits or are part of an unmodified ash deposit associated with burning in the pit.

Fill found in the pits Burial 2 (F24) and Burial 3 (F35) comprised the sediment samples analyzed here. Burials typically yield few carbonized plant remains. If plant offerings are made, they are typically uncarbonized, found in discrete locations within the burial pits or graves, and consist of a restricted number of taxa. The high diversity and density values for the contents of Burial 2 clearly indicates contamination from nearby midden deposits, as suspected. The very

Hearth in Structure:	PS-1	"A" RR-1	PS-3	"B" RR-1	PS-2
TYPE Volume (L):	19.3	4.9	0.9	3.0	9.3
SEEDS					
Amaranthus sp.	0.15(3)	0.20(1)			0.12(1)
Artemisia sp.	0.47(9)				
Asteraceae	0.15(3)				0.12(1)
Brassicaceae	0.05(1)				0.10(1)
Chenopodium spp.	51.35(991)	1.02(5)			
Cheno-Ams	13.26(257)	1.02(5)	4.44(4)	2.33(7)	1.08(10)
Helianthus sp.	0.15(3)			0.33(1)	
Juniperus sp.	0.15(3)				
Mentzelia sp.		0.20(1)		0.33(1)	
Poaceae type 1			1.11(1)		0.22(2)
Poaceae cf.	0.05(1)				
Phaseolus vulgaris	0.05(1)				
Physalis sp.	0.05(1)				
Sphaeralcea sp.	0.10(2)	0.20(1)			
Suaeda sp.	0.05(1)				
Yucca bacatta					0.43(4)
Zea mays					
kernel, whole	0.05(1)			0.67(2)	
kernel, fragment	0.31(6)	5.10(25)		7.33(22)	5.16(48)
kernel, fragment cf.				5.67(17)	
Unknown type	0.05(1)	0.20(1)			
Unidentifiable seeds	3.26(63)	6.12(30)	3.33(3)	4.00(12)	2.47(23)
Totals[b]	69.79(1347)	14.08(69)	8.89(8)	20.67(62)	9.68(90)
PLANT PARTS[c]					
Wood	17.89(345.20)	1.78(8.71)	43.40(39.06)	2.07(6.22)	13.93(129.54)
Zea mays:					
cupule	0.12(2.22)	0.08(0.41)	0.28(0.25)	0.34(1.01)	0.01(0.11)
glume	(<0.01/3)	*(<0.01/1)	*(<0.01/1)		*(0.004)
scutellum		*(0.01)		0.01(0.03)	*(0.01)

Table 10.3. Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the hearth samples.

Pinus sp.:					
leaf (needle)	*(0.008)		*(<0.01/2)		
bark	0.04(0.68)	0.13(0.64)	*(0.003)	0.09(0.26)	0.31(2.87)
nutshell	*(0.02)				*(<0.01/3)
ovulate cone fragment	*(0.02)				
Juniperus sp.:					
leaf (scale)	*(0.03)	*(<0.01/1)	*(<0.01/7)	*(<0.01/1)	
Amorphous	0.05(1.03)	0.08(0.41)	0.04(0.03)	0.01(0.04)	0.01(0.12)
Unknown plant part	0.78(15)	2.04(10)			3.98(37)

[a] Values in parentheses are raw counts and weights.
[b] Seed totals include unidentifiable seeds and fragments.
[c] Values in parentheses are weights (in grams) except unknown plant part(s). Weights < 0.001 g are followed by counts.
* Denotes densities < 0.01 g/L.

Table 10.3 (continued). Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the hearth samples.

small sample size of Burial 3 fill precludes any firm conclusions being drawn, even though it too appears to be contaminated by midden deposits.

DISCUSSION

The results presented here represent the largest accounting of macrobotanical remains yet reported from a single late Pueblo II Virgin Anasazi site (Allison 1990; Heath 1986, 1988a, 1988b; Martin 1996a; Newman 1990; Valdez 1993; Van Ness 1987; Westfall et al. 1987). This is due in part to the excellent preservation of plant remains at this buried site and indicates that open-air sites found in the region do undergo considerable post-depositional change as regards the quality and quantity of organic remains. The sampling and processing techniques employed in this study might also have led to a greater recovery of macrobotanicals; however, this is more difficult to assess given the poor reporting of methods by other researchers. Most of these researchers have tended to pre-treat their samples, either by sieving or wet-screening, which can destroy macrobotanical material and, if these screened fractions are not analyzed (e.g., Heath 1986), lead to biased results. None have indicated testing the recovery rate of their respective flotation systems and few report sediment volumes, making quantitative comparisons within and between sites, as well as between recovery techniques, difficult.

In spite of the shortcomings of previous studies and the excellent recovery from the Arroyo site, the results presented here still conform to the pattern of subsistence that has emerged from previous investigations. That is one of a heavy reliance on agricultural products (namely maize) and the exploitation of a limited number of locally available wild plants that supplemented the diet. Maize (kernels and kernel fragments) was the most ubiquitous (78.3%) taxon recovered. The innumerable kernel fragments from the lower floor in Storage Room 1 aside, 215 kernel and kernel fragments were recovered from 18 of the 23 discreet deposits sampled. In addition, maize cob fragments were recovered from all of the sediment samples. Although maize cobs were used as fuel and do not represent actual consumption, their ubiquitous nature, paralleled by the edible portions of the plant, reinforces the notion that maize was a dietary staple. Further, a stable carbon isotope ratio analysis of the bone collagen from three individuals recovered from the site indicates that 85±10% of the annual calories were derived from maize (Martin 1999). This over reliance on maize may explain some of the pathological conditions (e.g., porotic hyperostosis) noted on some of the skeletal remains recovered from the site (Edgar, this volume).

Feature:	PS-1	RR-1	SR-1 lower	SR-1 upper	PS-3	PS-2	PS-4	PS-3, floor pit
TYPE Volume (L):	2.2	9.0	1.9	1.8	0.7	3.9	1.3	0.4
SEEDS								
Amaranthus sp.	1.82(4)		1.05(2)	0.56(1)		0.26(1)		
Brassicaceae			0.53(1)					
Chenopodium sp.	0.91(2)						1.54(2)	
Cheno-Ams	1.36(3)		14.21(27)		1.43(1)			2.50(1)
Malvaceae			0.53(1)					
Mentzelia sp.			2.63(5)					
Oenothera sp.			2.63(5)					
Stipa hymenoides	0.45(1)	0.11(1)	1(0.53)					
Phaseolus vulgaris		0.22(2)					0.77(1)	
Poaceae type 1						4.36(17)		
Scripus sp.		0.11(1)						
Sphaeralcea sp.		0.11(1)						
Zea mays								
kernel, whole							2.30(3)	
kernel, fragment	1.36(3)	2.11(19)	1.58(3.00)[b]			0.26(1)		
Unknown type 1			2.16(4)					
Unknown type	3.36(8)		2.63(5)			0.77(3)		
Unidentifiable seeds	2.25(5)	2.33(21)	23.16(44)	2.22(4)		2.31(9)	2.30(3)	
Total[c]	11.82(26)	5.00(45)	50.00(95)	2.78(5)	1.43(1)	7.95(31)	6.92(9)	2.50(1)
PLANT PARTS[d]								
Wood	2.28(5.02)	3.13(28.20)	4.97(9.44)	0.34(0.62)	1.04(0.73)	1.17(4.58)	4.09(5.32)	0.14(0.05)
Zea mays:								
cupule	0.11(0.23)	0.36(3.22)	0.21(0.40)		0.10(0.07)	0.12(0.45)	0.09(0.12)	
glume		*(0.004)						
embyo			*(<0.01/23)					
scutellum			0.04(0.08)				*(<0.01/1)	
Pinus sp.:								
leaf (needle)			*(0.01)		*(<0.01/1)		0.39(0.50)	
bark	0.03(0.07)	0.03(0.26)		0.02(0.03)	0.02(0.01)	0.02(0.07)	0.05(0.07)	
nutshell							0.02(0.02)	
ovulate cone fragment							0.74(0.97)	

Table 10.4. Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the floor contact samples.

Juniperus sp.:								
leaf (scale)	*(<0.01/2)		0.09(0.17)			*(<0.01/5)		
terminal bud		*(<0.01/1)						
Monocotyledon stem			*(0.01)					
Amorphous	*(0.01)	0.14(1.29)	0.53(1.01)	0.02(0.03)				
Unknown plant part	3.15(7)	3.33(30)	5.26(10)			1.28(5)	0.77(1)	

[a] Values in parentheses are the raw counts and weights.
[b] Due to the high number of fragments, weight and densitiy (g/L) values are given here.
[c] Seed totals include unidentifiable seeds and fragments.
[d] Values in parentheses are weights (in grams) except unknown plant part(s). Weights < 0.001 g are followed by counts.
* Denotes densities < 0.01 g/L.

Table 10.4 (continued). Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the floor contact samples.

The most ubiquitous wild types recovered in this study - such as goosefoot, pigweed, sunflower, stickleaf, and purslane - are weedy annuals that thrive in disturbed soils (Kearney and Peebles 1960; Welsh et al. 1993). Considerable amounts of these edible weedy annuals would have been made readily available as a result of habitation and agricultural disturbances. In fact, their growth within agricultural fields was probably encouraged through selective weeding (Dobyns 1979; Ford 1984; Minnis 1978), a practice that was observed for the Hopi (Whiting 1939:16) and the Tewa of San Juan Pueblo (Ford 1968:190). Additionally, agricultural fields are often found in sandy soils that would have attracted cacti and grasses (e.g., Indian rice grass) when left fallow.

Agricultural activities also restrict the amount of time devoted to wild plant collection. Ethnographic evidence indicates that wild plant collection among the Pueblo Indians was small-scale, opportunistic, and scheduled so as not to interfere with agricultural practices (Ford 1968; Stevenson 1915; Whiting 1939). The marginal environment within which the Virgin Anasazi lived resulted in the irregular, unpredictable, and sparse distribution of edible wild plants. Given that all of the wild plants found in Table 10.1 would have been locally available, their collection would not have interfered with agricultural activities. The many weedy annuals that would have been made readily available as a result of agricultural disturbances would have made gathering a small-scale, home-based affair.

The results presented here indicate that the Virgin Anasazi inhabitants of the Arroyo site were full-time maize agriculturalists who did not practice a mixed economy. In fact, the over-reliance on maize appears to have resulted in episodes of nutritional stress, which are evidenced by the pathological conditions noted above. Additionally, those wild plants that were exploited in great numbers are those that would have been associated with agricultural practices and sedentary habitation activities (i.e., ruderal types) making plant collection a small-scale, domestic affair.

Feature	F6	Burial 2	Burial3
TYPE Volume (L):	1.5	3.4	0.2
SEEDS			
Amaranthus sp.		2.90(10)	
Asteraceae		3.71(13)	
Chenopodium spp.	0.67(1)	16.47(56)	25.0(5)
Cheno-Ams	0.67(1)	11.92(41)	5.00(1)
Helianthus sp.		1.18(4)	
Malvaceae		0.59(2)	
Mentzelia sp.			
Poaceae		1.18(4)	
Portulacaceae		2.65(9)	
Sphaeralcea sp.		1.47(5)	
Sphaeralcea sp. cf.			
Yucca bacatta		0.29(1)	
Zea mays			
kernel, fragment	0.67(1)	4.41(15)	20.0(4)
Unknown type		0.29(1)	
Unidentifiable seeds		11.71(41)	
Total[b]	2.00(3)	59.41(202)	50.00(10)
PLANT PARTS[c]			
Wood	1.71(2.57)	5.34(18.17)	8.51(1.70)
Zea mays:			
cupule	0.01(0.02)	0.23(0.78)	0.44(0.09)
glume		*(<0.01/2)	*(<0.01/1)
scutellum			
scutellum cf.		*(<0.01/1)	
Pinus sp.:			
leaf (needle)		*(0.01)	
bark	*(0.01)	0.04(0.13)	0.10(0.02)
nutshell		*(0.01)	*(<0.01/2)
ovulate cone fragment		0.05(0.18)	0.25(0.05)
Juniperus sp.:			
leaf (scale)		*(<0.01/14)	*(<0.01/2)
Monocotyledon stem		0.02(0.08)	
Parallel sided		*(<0.01/2)	*(<0.01/1)
Amorphous	*(0.01)	*(<0.01/1)	
Unknown plant part		5.00(17)	5.00(1)

[a] Values in parentheses are raw counts and weights.
[b] Seed totals include unidentifiable seeds and fragments.
[c] Values in parentheses are weights (in grams) except unknown plant part(s). Weights < 0.01 g are followed by counts.
* Denotes densities < 0.01 g/L.

Table 10.5. Carbonized plant material densities (counts/liter or grams/liter) and raw counts and weights[a] for the feature fill samples.

Chapter 11
Pollen Analysis
by
Linda Scott Cummings

Ten pollen samples were examined from Site 42Ka3976, a late Pueblo II site occupied between approximately AD 1050 and 1150. These samples represent floor, midden deposits, and trash deposits from several locations within this site. A few widely spaced samples were collected in a column running from the Anasazi midden through and below what appears to be an Archaic pit structure dating to approximately 1500 BC. Pollen analysis was undertaken to identify subsistence activity associated with both of the occupations represented.

METHODS

A chemical extraction technique based on flotation is the standard preparation technique used in this laboratory for the removal of the pollen from the large volume of sand, silt, and clay with which they are mixed. This particular process was developed for extraction of pollen from soils where preservation has been less than ideal and pollen density is low.

Hydrochloric acid (10%) was used to remove calcium carbonates present in the soil, after which the samples were screened through 150 micron mesh. The samples were rinsed until neutral by adding water, letting the samples stand for 3 hours, and then pouring off the supernatant. A small quantity of sodium hexametaphosphate was added to each sample once it reached neutrality, then the beaker was again filled with water and allowed to stand for 3 hours. The samples were again rinsed until neutral, filling the beakers only with water. This step was added to remove clay prior to heavy liquid separation. After the clay was removed the samples were dried and powdered. The dry samples were mixed with zinc bromide (density 2.1) for the flotation process. The heavy liquid separation was repeated at least once. All samples received a short (20 minute) treatment in hot hydrofluoric acid to remove any remaining inorganic particles. The samples were then acetolated for 3 minutes to remove any extraneous organic matter. This method also recovers starch granules present in the samples.

A light microscope was used to count the pollen to a total of 100 to 200 pollen grains at a magnification of 500x. Starch granules, when present, are tabulated along with pollen. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University and the University of Colorado Herbarium was used to identify the pollen to the family, genus, and species level, where possible.

Pollen aggregates were recorded during identification of the pollen. Aggregates are clumps of a single type of pollen and may be interpreted to represent pollen dispersal over short distances, or the actual introduction of portions of the plant represented into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is noted by an "A" next to the pollen frequency on the pollen diagram. A plus (+) on the

Sample #	FS #	Feature	Description	Pollen Counted
1	294	7 (RR-1)	Packed floor of a large habitation room in room block	134
2	296	19	Floor contact, clay over slabs on the lower floor of a storage unit in room block	200
3	287	2	Soil (column) from a midden of main Anasazi occupation, above the apparent floor and hearth of the Late Archaic pit structure/habitation (Feature 21)	200
4	290		Soil (column) from 40cm above the apparent floor and hearth of the main pit structure/habitation (Feature 21), non-cultural	200
5	288	12/21	Soil (column) from the apparent floor and hearth depression in the Late Archaic pit structure/habitation (Feature 21)	100
6	289		Soil (column) from 20cm below the apparent floor and hearth surface in the Late Archaic pit structure/habitation (Feature 21), non-cultural	101
7	176	34	Soil from under a milling stone near the apparent west wall of the Late Archaic pit structure/habitation (Feature 21)	100
8	15	3 (PS-1)	Floor contact, packed floor of a deep, unlined pit structure	200
9	297	11 (PS-2)	Fill from a trash deposit in a second deep, unlined pit structure	200
10	295	11 (PS-2)	Fill, packed floor of a second deep, unlined pit structure	202

Table 11.1. Provenience data for samples from site 42Ka3976.

pollen diagram indicates that the pollen type was observed outside the regular count while scanning the remainder of the microscope slide.

Indeterminate pollen includes pollen grains that are folded, mutilated, and otherwise distorted beyond recognition. These grains are included in the total pollen count, as they are part of the pollen record.

ETHNOBOTANIC REVIEW

Members of the Apiaceae family, including but not limited to Cymopterus, *Lomatium*, and *Pseudocymopterus*, are noted to have been used. The roots, stems, and leaves of these plants may be used for food, seasoning, and medicine (Colton 1974:305; French 1971:385 412; Whiting 1939:86).

Cheno ams are a group of plants that include the goosefoot family (*Chenopodiaceae*) and pigweed (*Amaranthus*) and were exploited for both their greens (cooked as potherbs) and seeds. The greens are most tender when young, in the spring, but may be used at any time. The greens may be harvested and cooked either alone or with other food, or be packed around yucca fruits when they are baked. The seeds were ground and used to make a variety of mushes and cakes and were frequently mixed with cornmeal. The seeds are usually noted to have been parched prior to grinding. *Chenopodium* and *Amaranthus* are both weedy annuals capable of producing large quantities of seeds. *Atriplex*, which occurs as both an annual herb and perennial shrub, also may be exploited for both its greens and seeds. Saltbush leaves have a salty taste and have been used as a seasoning. Saltbush seeds do not ripen until mid fall and may remain on the shrubs throughout the winter into the next growing season (Chamberlin 1964:366; Colton 1974:300; Cushing 1920:244 5; Gallagher 1977:12 16; Harrington 1967:55, 57, 71; Nequatewa 1943:19; Schopmeyer 1974; Stevenson 1915:66; Whiting 1939:73 4). The greens are

available and most succulent during the spring and early summer, although they may be gathered and used at any time during the growing season. The seeds may be harvested in the late summer and fall.

Cleome (beeweed) was used both as a food and a pottery paint. The young plants are usually gathered and boiled for food from spring until mid summer. Both the young and older plants may be gathered and the entire plant boiled until the water is thick and black. This fluid is then dried and made into cakes, which keep for an indefinite period. The cakes may be reconstituted by soaking them in water for use as pottery paint, or fried in grease to be eaten. The Zuni also gathered large quantities of leaves that were hung indoors to dry for winter use. The seeds also may be gathered and ground into meal, although utilization as a potherb appears to have been more common (Harrington 1967:72; Robbins et al. 1916:58 9; Stevenson 1915:69,82; Whiting 1939:77 8). *Cleome* is noted to have been allowed to grow in gardens with cultivated plants. At Hano, it was named with the three chief cultivated plants: corn, pumpkin, and cotton (Whiting 1939:77 8). As with *Cheno ams*, the greens may be harvested at any time during the growing season, although they would be tenderer during the spring and early summer. The seeds ripen in the late summer and fall.

Ephedra (Mormon tea) is noted to have mainly medicinal uses. A beverage may be made from the dried stems and flowers. The tea may be used as a remedy for diarrhea, although the most frequently mentioned cure is for syphilis (Colton 1974; Robbins et al. 1916; Stevenson 1915; Whiting 1939).

Opuntia (prickly pear cactus) and *Cylindropuntia* (cholla cactus) were both utilized, frequently in similar ways. *Cylindropuntia* is an antiquated term for cholla cactus which has been applied in palynology to distinguish cholla cactus from prickly pear cactus (*Opuntia*). Cholla buds are collected during the spring and roasted. The fruits or tunas of both cholla and prickly pear cactus also were collected for consumption, as were the joints of both cacti. The pads or joints or prickly pear cactus were boiled and eaten, frequently with syrup. The fleshy fruits may be eaten fresh or dried, while non-fleshy fruits were frequently boiled or dried and ground into meal. The process of removing the spines from the cacti usually involves roasting or baking in a pit, and rubbing the spines off (Beaglehole 1937:70; Greenhouse et al. 1981; Kearney and Peebles 1960:581 586; Nequatewa 1943:18 9; Robbins et al. 1916:62; Stevenson 1915:69; Whiting 1939:85 6). *Mammillaria* (pincushion cactus) resembles *Echinocactus* (ball cactus) both in form and in having small seeds. Ethnographic accounts for the use of *Echinocactus* include reference to the use of the fruit, stems, and seeds for food. The small black seeds, when parched and ground, are noted to make good bread or mush (Bye 1972; Castetter 1935; Palmer 1871). Prickly pear fruits ripen during the summer and fall, whereas the pads may be harvested at almost any time of year.

Shepherdia (silverberry and buffaloberry) bear edible fruit. These fruits were sometimes eaten raw, although they were more often cooked into a sauce used to flavor buffalo meat, hence the common name. When fresh, the fruits may be ground, seeds and all, and shaped into patties, which may then be dried. The dried berries also may be used to make a beverage. In addition, the berries are noted to have been dried for winter use (Harrington 1967:282 285). *Shepherdia argentia* (silverberry) grows along streamsides.

Members of the Solanaceae (nightshade) family, primarily *Solanum* and *Physalis* (tomatillo, ground cherry), were exploited for food. *Physalis* was domesticated in Mexico and naturalized in Eastern North America. The berries may be eaten raw or cooked and made into preserves and pies, but taste best when fully ripe. Boiled berries are frequently used in sauces such as chile verde and green chile. Some species are commercially cultivated for their berries. Ground cherries are found in moist to medium dry, open ground throughout the West (Kirk 1975). *Solanum* berries also are edible, as are the roots (Robbins et al. 1916:59,70 3; Stevenson 1915:70; Whiting 1939:90). Wild potato (*S. jamesii*) is noted to have been allowed to grow as a weed in otherwise carefully tended agricultural plots (Whiting 1939:16).

Sphaeralcea (globemallow) root was used medicinally and to make a paint. A tea may be made from the boiled root (Colton 1974:362 3; Robbins et al. 1916:61; Stevenson 1915:98; Whiting 1939:85). Some other members of the *Malva*ceae family which are noted to have been eaten include *Malvastrum*, which was used by the Pima Indians in times of scarcity, *Malva* (cheese weed), which also

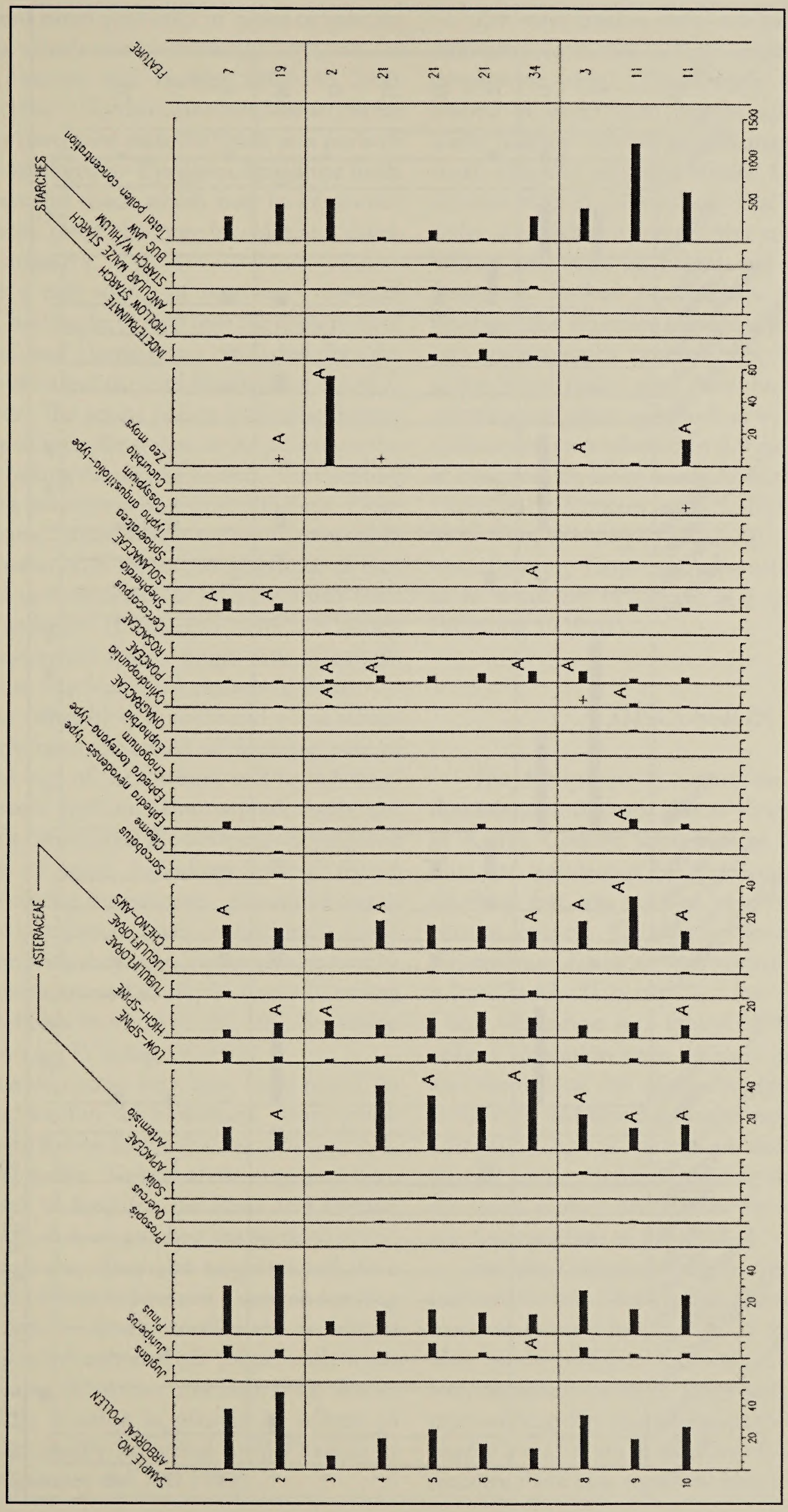


Figure 11.1. Pollen diagram.

Figure 11.1 (continued). Pollen dagram.

was boiled and eaten primarily in times of scarcity, and Sidalcea, which was occasionally exploited for its greens (Kearney and Peebles 1960:548 549). Harrington (1967:317) also notes that *Malva* (cheese weed) greens have been exploited both as a potherb and as a raw salad green. The green, immature fruits also are a flavorful snack which may be consumed raw. The entire plant also may be collected, dried, and used to make tea.

Typha is a rich source of nutrients. Steward (1938) and Chamberlin (1964) note the utilization of cattail as food; and Harrington (1967) describes the use of both pollen and the seed like fruits of cattail as food resources. The young pollen producing flowers may be stripped from the spikes, or the pollen may be removed by shaking the mature flowers. The resulting flowers and/or pollen may be mixed with flour. Flour made from cattail roots, which are best harvested in the fall, is similar with respect to quantities of fats, proteins, and carbohydrates to flour obtained from wheat, rice, and corn (Harrington 1967). Claasen (1919) has estimated that a single acre of cattails may produce as much as 6,475 pounds of flour.

Cucurbita (squash) is a cultivated plant which has frequently been described as forming part of the cultivated trio of corn, beans, and squash used by Southwestern Indians. Both squash fruits and flowers may be consumed. The fruits may be prepared in a variety of ways, including boiling, frying, stewing, and drying for later use. Squash blossoms may be made into pats or cakes, or used medicinally in conjunction with the seeds. The seeds also may be roasted and eaten, or used to oil piki stones (Cushing 1920:228; Robbins et al. 1916:100 102; Stevenson 1915:44 45, 66 67; Whiting 1939:93).

Gossypium or cotton may have been raised for both fiber and food by the Hohokam. Many goods were made with cotton lint, including cordage, cloth, garments, and tinder. Cotton seeds may have been a useful source of food for the Pima and Papago, who are known to have parched the seeds to eat, as one would popcorn. They also might pound them with mesquite (*Prosopis*) beans in a mortar, forming the mixture into a cakelike tortilla and cooking it in ashes. Pounded cotton seeds mixed with water made a seasoning (Castetter and Bell 1942; Gasser 1982:219-220). Cotton is planted in March or April and not usually harvested until October or November (Castetter and Bell 1942).

Zea mays (maize, corn) has been an important cultivated food, for which innumerable ways of preparation exist. The kernels may be parched, soaked in water with juniper ash, and boiled to make hominy. Dried kernels may be ground into meal, which is used as a staple. Cornmeal may be colored with *Atriplex* ashes. Black corn is used as a dye for basketry and textiles and as body paint. Whole ears may be boiled and eaten. Corn is frequently husked immediately upon harvesting, limiting the quantity of corn pollen introduced into archaeological proveniences. Seed corn retains a few inner husks, and clean husks are saved for smoking and other uses, such as wrapping food. The ordinary ears are allowed to dry on the roof. Ristras of corn may be hung inside from the roof (Cushing 1920:264 7; Robbins et al. 1916:83 93; Stevenson 1915;73 6; Whiting 1939:67 70). "Corn appears in virtually every Hopi ceremony either as corn meal, as an actual ear of corn or as a symbolic painting" (Whiting 1939:67).

DISCUSSION

The Arroyo site is located on the edge of the floodplain on the west side of Kitchen Corral Wash in Kanab County, southwestern Utah (Fig. 1.4). This site was buried by approximately a meter of alluvium, but was exposed by a recently-cut, deep, narrow arroyo. Excavations revealed an Archaic pit structure dating to approximately 1500 BC and a late Pueblo II occupation (ca. AD 1050-1150). Local vegetation was typical of the southwestern upland vegetation zone. Ridges and higher mesas are dominated by pinyon/juniper (*Pinus edulis/ Juniperus*). The broad drainage supported sagebrush (*Artemisia*) and a variety of disturbance species. Several features were exposed by the arroyo and are discussed as they occur from the northwest to the southeast portion of the site.

Sample 1 represents the packed floor of a large habitation room (Residential Room 1) in the room block at the northwest edge of the site (Fig. 3.1). This room contains a hearth. Pollen recovered from sample 1 includes *Pinus* and *Juniperus* pollen, representing the pinyon/juniper woodland on the nearby mesa. A small quantity of *Juglans* pollen was recovered and may represent long distance transport

Scientific Name	Common Name
ARBOREAL POLLEN:	
Juglans	Walnut
Juniperus	Juniper
Pinus	Pine
Prosopis	Mesquite
Quercus	Oak
Salix	Willow
NON-ARBOREAL POLLEN:	
Apiaceae	Parsley/carrot family
Asteraceae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Tubuliflorae	Includes eroded Low- and High-spine
Liguliflorae	Includes dandelion and chicory
Cheno-ams	Includes amaranth and pigweed family
Sarcobatus	Greasewood
Cleome	Beeweed
Ephedra nevadensis-type	Mormon tea
Ephedra torreyena-type	Mormon tea
Eriogonum	Wild buckwheat
Euphorbia	Spurge
Onagraceae	Evening primrose family
Opuntia	Prickly pear cactus
Cylindropuntia	Cholla cactus
Poaceae	Grass family
Rosaceae	Rose family
Cercocarpus	Mountain mahogany
Shepherdia	Buffaloberry
Solanaceae	Potato/tomato family
Sphaeralcea	Globemallow
Typha angustifolia	Cattail
Gossypium	Cotton
Cucurbita	Squash, pumpkin, gourd
Zea mays	Maize, corn
STARCHES:	
Hollow Starch	
Angular Maize Starch	
Starches with Hilum	

Table 11.2. Pollen types observed in samples from site 42Ka3976.

to the site. Pollen representing local vegetation includes *Artemisia*, Low-spine and High-spine Asteraceae, Tubuliflorae-type Asteraceae, Cheno-am, *Sarcobatus*, *Ephedra*, Poaceae, and *Shepherdia*. The moderate quantity of *Shepherdia* pollen accompanied by a single large and a few small aggregates indicates that buffalo berry was a common member of the local vegetation community, probably along the floodplain. A small quantity of hollow starch granules probably represents the deterioration of grass seeds. The presence of a few small aggregates of Cheno-am pollen might reflect economic activity, but is not sufficient for a positive interpretation.

Sample 2 was collected from Storage Room 2, a storage room adjacent to Residential Room 1 (Fig. 3.1). Sample 2 was collected from the floor contact, which was described as clay over slabs on the lower floor in this storage unit. The pollen record in Sample 2 is very similar to that in Sample 1. The record again is dominated by *Pinus* pollen, with a smaller quantity of *Juniperus* pollen representing the local pinyon/juniper woodland. Pollen representing local shrubs, forbs, and grasses also was similar. Differences in the record include small quantities of Apiaceae, *Cleome*, *Cylindropuntia*, and *Zea mays* pollen recovered from the storage room. All of these plants are noted to have been important economically and recovery of their pollen from this storage room suggests the probability that the edible portions of these plants were stored.

The arroyo cut through a Late Archaic pit structure/habitation feature designated F21 and F34 (Fig. 3.1). This feature was overlain by a midden associated with the main Anasazi occupation of the site (Fig. 5.2). Sample 3 was collected from this midden, while samples 4, 5, and 6 were collected above, within, and below the Late Archaic pit structure. Sample 7 was collected beneath a milling stone located on the western portion of the pit structures floor (Fig. 5.4). Sample 3, representing the Anasazi midden, was dominated by *Zea mays* pollen, and accompanied by several aggregates of small to moderate size. Undoubtedly, this reflects discard of maize remains such as husk and silk, that transport a moderately large quantity of *Zea mays* pollen. A small quantity of *Cucurbita* pollen also was recovered from this sample, and indicates the discard of squash/pumpkin. In general, this sample reflects the local vegetation including the pinyon/juniper woodland on the mesa top and the shrub and forb vegetation community of the floodplain. Small quantities of Apiaceae and *Cylindropuntia* pollen probably reflect the discard of remnants of these plants after processing. Although the Poaceae pollen frequency is relatively small, this sample exhibited a moderate- size aggregate that might be associated with the discard of grass remains. Alternatively, grasses may have grown in the disturbed area of the midden. It is surprising that the Cheno-am frequency is neither elevated nor accompanied by aggregates in this sample. Cheno-ams are expected to grow in disturbed areas such as middens.

The samples collected and examined from the Archaic pit house exhibit a pollen record different from all of the Anasazi samples. The Late Archaic samples are dominated by *Artemisia* pollen and quantities of *Pinus* and *Juniperus* pollen are generally smaller than those noted in the Anasazi samples. Other elements of the local vegetation community such as Asteraceae, Cheno-ams, *Sarcobatus*, *Ephedra*, and Poaceae are represented in the Archaic samples. *Shepherdia* pollen is usually absent from the Archaic samples. Sample 4 was collected from a presumed sterile deposit between the Anasazi midden and the Archaic pit house. A very small quantity of pollen transport through either downward migration or bioturbation is noted in this sample. The small quantity of *Zea mays* pollen recovered from this sample could only be accounted for by contact with the overlying midden. Likewise, recovery of the angular maize starch in this sample also represents downward movement of this remain, since this particular type of starch granule is specific to *Zea mays* and has not been noted in other grasses. All other components of this sample, with the possible exception of the small quantity of *Shepherdia* pollen, appear to represent natural vegetation present in this area between the Late Archaic and Anasazi occupations.

Sample 5 was collected from the apparent floor and hearth depression within the Late Archaic pit structure (Fig. 3.2). This sample exhibits general similarities with Sample 4 above it. Differences include the presence of small quantities of *Salix* and Liguliflorae-type Asteraceae pollen. Both of these pollen types represent plants common in floodplains or along drainages. Also recovered were small quantities of hollow starch granules and starch

granules with hila. These starch granules are typical of those produced by grass seeds and might represent the processing of grass seeds in this structure.

Sample 6 was collected below the apparent floor and hearth surface of the Late Archaic structure from a presumed sterile deposit (Fig. 3.12). In general, this sample was similar to Samples 4 and 5 with regard to pollen representing the local pinyon/juniper and floodplain vegetation communities. A small quantity of *Typha* pollen was noted in this sample reflecting proximity to the riparian community of Kitchen Corral Wash. Recovery of this pollen indicates that cattail likely were present and available for exploitation by the Late Archaic occupants of this structure.

Sample 7, collected beneath the milling stone found on the western portion of the Late Archaic pit structure, exhibited pollen typical of this pit structure. Notable elements of the pollen record include recovery of a larger quantity of *Artemisia* aggregates than has been noted in other samples, recovery of Cheno-am and Poaceae aggregates, and Solanaceae pollen and aggregates. Starch granules with hila also were present. The pollen record from this sample indicates the possibility that sagebrush seeds, Cheno-am seeds, grass seeds, and a member of the Solanaceae (potato/tomato), family such as ground cherry, probably were processed using this milling stone.

Sample 8 represents the packed floor of Pit Structure 1 which occurs on the north side of the arroyo (Figs. 3.1, 3.18). This sample represents an Anasazi occupation and includes both *Zea mays* and a *Pinus*, *Juniperus*, and *Artemisia* signature typical of the Anasazi occupation. Pollen types that might reflect economic activity on the floor of this structure include Apiaceae, the slightly elevated Cheno-am frequency accompanied by aggregates, *Cylindropuntia*, Poaceae, and *Zea mays* pollen, also accompanied by a single small aggregate.

Pit Structure 2, noted slightly farther southeast and on the south side of the arroyo, yielded two pollen samples for analysis (Fig. 3.1). Sample 9 represents the trash deposit (Fig. 3.36) and Sample 10 represents the packed floor (Fig. 3.37). Both samples exhibit typical pollen expected for the local pinyon/juniper and sagebrush vegetation zones during the Anasazi occupation. Sample 9 exhibited an increased variety in pollen types. The Cheno-am frequency in this sample was elevated, although only a few small aggregates were noted. The *Ephedra* pollen frequency was elevated and accompanied by a single small aggregate, indicating the possibility that this resource was exploited, possible for its medicinal qualities. Small quantities of *Cylindropuntia*, Poaceae, *Shepherdia*, and *Zea mays* pollen also might reflect economic activity and subsequent discard of remains in this midden.

Sample 10, representing the floor, exhibits a few differences from Sample 9 in the trash midden. Small quantities of Apiaceae and Liguliflorae-type pollen were recovered. A much larger quantity of *Zea mays* pollen was recovered, accompanied by a few small aggregates. This may reflect either food processing activities or ceremonial activities. A single *Gossypium* (cotton) pollen was noted in this sample indicating that the Anasazi occupants of this site had access to or grew cotton. Small quantities of *Cylindropuntia*, Poaceae, and *Shepherdia* pollen were similar to those noted in the midden and also might represent economic activity on this floor. *Sphaeralcea* pollen was present in both samples from this feature and may represent either local vegetation or medicinal activity.

SUMMARY AND CONCLUSIONS

Pollen analysis at the Arroyo site focused on recovering subsistence data from several features exposed by the arroyo. Assuming contemporaneity of the Anasazi features, the Anasazi occupants of this site appear to have been agriculturalists. Pollen evidence indicates that they grew, or possibly traded for, maize, squash/pumpkin, and cotton. They also exploited such native plants as a member of the umbell (carrot) family, Cheno-ams, beeweed, Mormon tea, cholla, grasses, buffaloberry, and possibly globemallow. Recovery of maize pollen was highest in the midden above the Late Archaic pit structure and in the floor sample from Pit Structure 2.

The Late Archaic occupation is distinguished from the Anasazi occupation in the pollen record by a large quantity of *Artemisia* pollen in all of the samples. In addition, *Juniperus* and *Pinus* pollen frequencies were diminished and *Shepherdia* pollen was nearly absent. These differences combine

to suggest that the sagebrush community in the floodplain was larger during the Late Archaic occupation than during the Anasazi occupation and that buffaloberry was probably not a significant component of the local vegetation. The sagebrush population in the floodplain would have been reduced if the area had been cleared for agriculture by the Anasazi occupants of the site. The Archaic occupants of the pit structure appear to have utilized or processed sagebrush, Cheno-ams, grasses, and a member of the potato/tomato family such as ground cherry.

Chapter 12
Summary and Conclusions

Following Jesse Jennings' line of reasoning once again: we have discussed how the dirt was moved, and have described the features, the artifacts, and the relationships between them. This chapter focuses on what is often the more difficult task of "thinking about the relationships". The following summarizes the findings of the descriptive chapters and considers them in light of the specific research design questions and problem domains discussed in Chapter 1. It is essentially a discussion of the data that includes observations in a larger, usually regional context. Those observations range from factual statements based on the existing data base, to outright speculations that expand future research directions and allow the formulation of new hypotheses.

CHRONOLOGY

By employing both ceramic cross-dating and chronometric dating we can arrive at an estimate of both the earliest possible occupation of the excavated structures at the Arroyo site, as well as the latest use of them. Initial occupation of the site, based on ceramic cross-dating of the floor-contact assemblages consisting of Tsegi Orangeware and the dominance of Moenkopi Corrugated over plain gray, indicates a post A.D.1050 date for the occupation of all formal features on the site (Ambler 1985). All of the radiocarbon dates, with the exception of two "old wood" dates from Pit Structure 2 (Beta -77114 and 77111), are in accord with this assessment.

Radiocarbon dates for the latest possible occupation of the structures on site also come from floor-contact proveniences. Determinations, at the 2 sigma range (95% probability) taken from carbonized seeds and structural material, suggest that the structures could have been occupied into the late 1200's – however, they also permit an interpretation for terminal use of the structures during the late A.D. 1100's. Exceptions are a carbonized post (Beta-77115) from PS-3 that yielded an A.D. 1250+ date and a corn kernel from PS-1 (Beta-117940) that also falls within the A.D.1200's.

Since all of the pit structures were filled with midden that held large quantities of household artifacts, it is obvious that the Arroyo site continued to be occupied well after the excavated structures were abandoned. Ceramics from the fill of the structures, however, do not include any Pueblo III types. Although the terminal date of occupation for the site cannot be determined with the data at hand, there is good evidence that the Arroyo site, and by extension the culture area, was occupied well after the traditionally cited date of A.D.1150. At present, Arroyo provides the best available data on the Grand Staircase section for persistence of the Virgin tradition into the thirteenth century.

ARCHITECTURE

The study of architecture in terms of its function, style, and history of construction conveys a wealth of information about cultural relationships, social identity and adaptive behavior. This is particularly true on the Grand Staircase where these issues are complicated by the close proximity of Kayenta and Virgin populations.

Regional Comparisons

Three types of residential structures were excavated at the Arroyo site: a jacale surface residential room (RR-1), two fully subterranean pit structures (PS-1, 2), and two miniature pit structures (PS-3, 4).

Surface Residential

Residential Room 1, is a lightly constructed jacale surface room with two occupation/floor surfaces and two superpositioned hearths. Modification of Storage Room 1 facilitated the incorporation of RR-1 into the roomblock. This configuration is not unlike surface rooms associated with early Pueblo II Virgin roomblocks in the St. George Basin (Walling et al 1986; Dalley and McFadden 1988).

Subterranean Pit Structures

Pit Structures 1 and 2 are fully subterranean earthen pit structures with slab-lined hearths, and in the case of PS-2, a deflector and vent shaft were also preserved. Lacking formal floor features such as a sipapu, there is no evidence that they functioned as anything other than domiciles. Deep pithouses, either lined with masonry or earthen, are known only in the uplands of the Virgin culture area and are not known to occur in the hot desert environment of the St. George Basin. One of the few reported from the uplands is Pit Structure 13 on the Reservoir site in Colorado City Arizona. Pit Structure 13, an earthen structure very similar to those at Arroyo, was radiocarbon dated to the Pueblo III period (Walling-Frank 1998). The "kiva" at the nearby Corngrower site (AZ B:1:102), a substantial linear unit pueblo, yielded a tree-ring date of 1148++v (McFadden 2000a). Aikens (1965) reported a deep masonry "kiva" at the Bonanza Dune site in Johnson Canyon with loom anchors in the floor. At Cottonwood Canyon Cliff Dwelling (42Ka1504, Judd's Cave 6), a fully-subterranean pit house with a recess on the north, appears to date to about A.D.1100; a large surface residential room was located adjacent to the structure (Judd 1927; Tipps 1989). From the perspectives of ritual versus residential use, it is worth noting that, at both the Cottonwood Canyon site and Bonanza Dune, the shallow pithouses had formal sand-filled floor pits of unknown use that, if not ritual, are distinctive. No such features occur in the succeeding deep pit structures.

Miniature Pit Structures

At the Arroyo site, miniature Pit Structures 3, 4, and probably Feature 6 represent a structure type that is apparently unique to the Virgin culture area. They have been identified in the St. George Basin at Quail Creek (Walling et al.1986), at the South Gate excavations in the St. George Basin (Dalley, report in preparation), and in the uplands at 42Ka2147 (McFadden 2000a). The structures on all of these sites date to Pueblo I times, which suggests considerable temporal depth for this type of structure. Their geographical range is taken as a comment on cultural continuity across the region.

Aikens described two similar small pit structures associated with Three Mile Ruin, a Late Pueblo II pueblo located along the Santa Clara River in the St. George Basin. Pit Structure 1 was roughly circular in outline with a diameter of 5ft. 10 in. and a depth of approximately 2 ft. 6 inches. It had a semi-circular clay-rimmed fireplace built against the northeast wall. The structure had been plastered twice. Pit Structure 2 was also circular, with a diameter of 4 ft. 11 in. A clay coped hearth identical to the one in PS-1, was built on the floor against the east wall of the structure. A ring of cobble stones formed the lower course of an upper wall for both structures. The floor of both pit structures had multiple coats of plaster indicating more than casual use (Aikens 1965).

Aikens (1965:57) speculated that "because of its small size, it seems unlikely that Pit Structure 1 was a regular dwelling unit, but the presence of a fireplace indicates that it had some domestic use. Perhaps it was a variant type of storage room, which functioned secondarily as a dwelling."The Arroyo site data suggest these structures functioned primarily as dwellings.

Intra-site Architectural Variability

Residential

What explanation best accounts for the range of residential structure types present on the Arroyo site? Given the site layout and dating of the structures, it seems likely that the three types were contemporary

with one another rather than part of an architectural sequence. The interpretation favored here is that both the surface residential room incorporated into the roomblock, as well as the deep pit structures, were seasonally used residences. The relatively flimsy jacal surface room would have maximized daylight, ventilation, and ease of access, making it most suitable for use during the summer as a residence and possibly other activities throughout the year. On the other hand, deep pithouses that lacked the above characteristics but provided excellent insulation from the cold, would have been most suitable for residence during the winter. They also could have been used year-round for a variety of other activities. A seasonally defined use of the two structural types then, at least allows that one or more of the pithouses and the surface room were in use at the same time. This is similar to the site layout during Basketmaker III, Pueblo I, and early Pueblo II times when shallow pithouses co-occurred with lightly constructed surface rooms built in front of the roomblock (Dalley and McFadden 1988; Walling et al. 1986).

While the pithouse and surface residential room types may have been complimentary – and therefore contemporary, the role of the several "mini" pit houses on the Arroyo site is problematic. They could have functioned for either a special use or as a habitation for an individual or two. Because they are well-insulated and efficiently heated, winter would have been the most suitable season of use. We can only speculate about the age, gender, social, and economic status of those individuals and under what circumstances they might occupy such a structure. One hypothesis is that they represented a minimal (but quite formal) residence used by a "caretaker" during fallow periods when most of the site occupants were absent. In this admittedly speculative scenario, the deep mini-pithouse may simply be considered the winter counterpart of the summer field house.

The exposure of five pit structures at Arroyo significantly changed our perception of site layouts during the Late Pueblo II period. Earlier survey work in the area indicated that the frequently (and terribly) looted areas south of the roomblocks held extremely rich, and inexplicably deep, midden deposits. The excavations at the Arroyo site demonstrated that at least on some Late Pueblo II sites the area to the southeast of the roomblock was favored for the construction of pit structures, as was the case during earlier periods. When abandoned (or perhaps "decommissioned"), the structures were purposefully filled with trash. The likely presence of multiple pit structures on these sites not only alters our perception of site layout and demography, it also adds a new opportunity to understand the history of site occupation. Unfortunately, it is precisely these areas which suffer the most from looting on the eastern Grand Staircase.

Storage

Over the course of nearly 1,000 years, Virgin storage architecture evolved from deep, slab-lined cists to surface masonry rooms. Basketmaker II randomly oriented individual cists gradually changed to an alignment of individual cists during BM III. By Pueblo I times, individual storage units were connected to form an arc or straight alignment. Low masonry walls built flush with the interior slabs served to increase their volume. By early Pueblo II times, the deep cists were replaced by a roomblock of shallow but still stone lined storage rooms; upper walls were typically jacal construction. It is not uncommon to observe finely dressed slab fragments salvaged from Basketmaker cists incorporated into the walls and floors of the later structures. Although part of a "roomblock", each storage room continued to be built separately and abutted to one another. Existing rooms were frequently remodeled with particular attention paid to the sealing of floors, often with multiple pavements. This form of roomblock persisted into the Late Pueblo II period, when both curvilinear and linear roomblock layouts were built. Although storage unit form and construction changed through time, the basic nature of the structure did not – the storage unit itself (as opposed to ceramic vessels) was a sealed, rodent and weatherproofed container. A second continuity was that roomblocks generally started small and grew as a result of accretion, rather than by construction as a unit. This trend persisted throughout the Virgin sequence however, by Late Pueblo II, entire roomblock segments and linear pueblos with "unit" architecture were also being constructed. These new forms have been described as a Kayenta trait (Aikens 1967).

The two excavated storage rooms at Arroyo, SR-1 and SR-2, both display multiple floors and

appear to have been built separately in typical Virgin fashion. Future work on site should elaborate on the history of use for the roomblock and the construction characteristics of each room.

Temporal Change

Pit structure architecture at Arroyo represents a distinct break with the continuity of the formal style that developed in the Virgin area from late Basketmaker III times circa A.D. 700 until the end of the Early Pueblo II period (A.D.1070). Earlier pithouse forms are well-represented in the area (Aikens 1965, Alstrom 2000, Nickens and Kvamme 1981, Walling and Thompson 2004) and nearly identical styles extend west to the St. George Basin (Dalley and McFadden 1988).These shallow, benched structures display a series of formal floor features oriented around the southerly axis of the vent shaft. Typical features include: a shallow ash pit, clay-coped hearth, a vault or "foot drum" (occasionally), and a series of enigmatic subfloor bins arranged in an arc on the north side of the floor. A series of posts on the bench, and later on the floor against the bench, supported the roof and the lower walls that were constructed of jacal.

The shift from the earlier benched pithouse, to a fully-subterranean style, appears to have been sudden and complete with no intermediate forms. An instance of superpositioning of the two styles is known to occur at the Cottonwood Cliff Dwelling site (Judd's Cave 6) near Kanab where a Pueblo I structure was cut by a deep pit structure (Judd 1926; Tipps 1989). At Bonanza Dune Aikens' masonry-lined "kiva" appears to be the final type in a long sequence of benched pit structures (Aikens1965).

Fully-subterranean pit structures are associated with the introduction of the Late Pueblo II ceramic assemblage, Bull Creek projectile points, and the appearance of the "L" shaped, masonry unit pueblo (McFadden 2002). Their geographical distribution is limited to the uplands of the Grand Staircase and the Arizona Strip; they have not been identified in the St George Basin where there is some question whether pithouses were constructed at all during Late Pueblo II times. That said, it should be noted that deep pithouses are also introduced to the Escalante-Boulder area during Late Pueblo II (Lister 1959).

CERAMICS

The intact and refitted vessel collection from the Arroyo site adds substantially to our knowledge of ceramic design layouts. In Chapter 6, Van Alfen properly typed the vessels according to Colton and their Kayenta design analogs, allowed a little leeway in some cases for local variation, and placed them in the local Virgin Series. They are now available for scholars of both the Virgin and Kayenta culture areas to ponder and argue about the significance of degrees of stylistic variability and what it means.

The designation of grayware sherds to the typological level of a ware is another story. Perry (Chapter 6) discusses the problems inherent in sorting plain and corrugated types into either the Virgin or Kayenta Series of Tusayan Gray Ware and Shinarump Gray Ware. Perry exercised restraint and opted to simply call most of the collection "local" and not assign a new name. There is no question that the range of variation in material composition for ceramics in the area can make identification difficult. Perry notes that while temper appears to be consistent, clay sources are much more variable. Variability in material composition of local ceramics has been noted by others who have attributed it to different (regional) origins for the vessels themselves; they inferred from this an "absence of local specialization." (Neff, Larson and Glascock 1997). In fact, there may well be sufficient variability in the Chinle clay sources of the Kitchen Corral Wash vicinity to produce this effect. Even though she noted that variability in ceramic clay sources occurred, Perry concluded that the ceramic assemblage at 42Ka3976 supports a "self-sufficiency model."

Perry's analysis of plain gray ceramics at the nearby BMIII-Pueblo I period Park Wash site (Perry 2000) suggests that this "local" type, whatever we ultimately choose to call it (although assignment to the Virgin tradition seems appropriate), has a long history in the Kitchen Corral Wash drainage. Fortunately, ceramic collections from both excavated sites and over 400 surveyed sites in the area are available to help sort out the problem. For now, it is suggested that the informal name "Kitchen Corral Wash variety, Shinarump Gray Ware" be used to refer to the type.

Slipped white wares, with similar paste and temper as the local gray ware, were readily classified as Shinarump White Ware (90.5%). Apparently these types are companion to the gray ware which suggests that the majority of the entire assemblage could be considered Shinarump Series. Although she does make the distinction between Virgin and Kayenta types, which make up the remaining (9.5%) of the painted sherds, both are considered intrusive to the area.

One significant change in nomenclature that appears to be a move in the right direction is the result of Margret Lyneis' work on the Shinarump Red Ware "problem" (Lyneis 1998). Although Perry remains consistent in the use of the term "local", the red ware appears to readily fall into the types Kanab Red, Kanab Black-on-red, and Kanab Polychrome suggested by Thompson (Walling et al. 1986) and supported by Lyneis (1998). Recently, consensus that Middleton Red Ware should be classified as Shinarump Red Ware has been reached (Allison 2008).

If our assumption is correct that Shinarump Red Ware is a local imitation of introduced Tsegi Orange Ware (San Juan Red Ware is always rare in the area), and assuming that Tsegi Orange was introduced just prior to A.D.1100 via a relatively brief flurry of trade or migration, then high ratios of Shinarump Red to Tsegi Orange may be an indicator of sites dating late in the 1100's or even into the 13th century. Perry describes about one quarter of the total red ware collection (N=527) as Tsegi orange ware types with the remaining 75% being locally made. The Arroyo site ceramic assemblage, all of which appears to postdate A.D.1150, offers support for this contention.

Whitewares may offer a similar opportunity for ceramic cross-dating. The lack of Flagstaff B/W and other Pueblo III ceramic types, in light of the Pueblo III era radiocarbon dates, suggests that Kayenta influence virtually ceased after A.D.1150. This may also account for the apparent "drift" of local design styles away from their original Kayenta analogs. Both of these opportunities for relative dating through the analysis of local assemblages hinge on the assumption that Virgin sites do, in fact, date well into Pueblo III times. Although a growing number of late radiocarbon dates suggest this possibility, the small number of tree-ring dates collected on the Grand Staircase does not, as yet, offer support for a Pueblo III occupation.

Summary

Perry concludes that "Based on pottery alone, a cultural affiliation of the locally made pottery cannot be satisfactorily assigned." This is sound reasoning, but in this section additional data that reflects on cultural affiliation is considered. Architectural types, styles, construction methods, and site layouts are perhaps the most concrete and traditional criteria for assigning cultural affiliation. Rock art, specifically the Cave Valley anthropomorph style observed elsewhere in the Kitchen Corral drainage system, is a ideological/sociological trait that suggests close contact and social identification with groups as far west as the St. George Basin.

The geographical distribution of Shinarump Series pottery, and by extension its area of manufacture, is exclusively north of the Colorado River. During late Puebo II times it is found on the eastern half of the Grand Staircase in Utah and on the Paria Plateau, House Rock Valley, the gorge of Marble Canyon, and the Kaibab Plateau in Arizona (Mueller 1974; McFadden 2004, 2010). As mentioned above, it is closely associated with other material culture items that are unique to the Virgin Anasazi. Perhaps the most compelling argument for the Shinarump Series being regarded as an indigenous Virgin type is its in situ development on the Grand Staircase during Basketmaker III times.

Regarding the compositional diversity of clay sources noted by Neff et al. (1997), the local "Kitchen Corral Wash variety" ceramic assemblage, consisting of gray ware, white ware, and red ware, does display a certain level of compositional diversity but, it is argued, the clay sources are most likely restricted to a region of manufacture north of the Colorado River. Although there are other ways to explain ceramic diversity within the region, simple trade being the most obvious, it is noted here that ceramic compositional diversity also supports a settlement model that household groups, periodically shifting among residences within the region, could have been the driving force for ceramic diversity.

TECHNOLOGY

Projectile Points

Difficulties with typing Virgin projectile points have been noted for some time. A review and revision of the Virgin projectile point origins, sequence, and nomenclature is probably in order. At the Red Cliffs site, Dalley noted "overlap or continuum" between the Virgin and Fremont series of the Parowan style (Dalley and McFadden 1985:111), at the Pinenut site Davis points out difficulties sorting the Eastgate series from the Parowan (Westfall 1987), and Geib et al. (2001) discusses the continuum of basal-notched Parowan points and what he termed Anasazi Short-stemmed points. St. George Basin examples of the type are reported from the Quail Creek excavations (Walling et al. 1986) and the Little Man sites (Dalley and McFadden 1988). Small basal-notched forms also occur in the Escalante River drainage where the type may represent either Fremont or Virgin Anasazi (Keller 2000). Nevertheless, regardless of nomenclature and origins, the "Parowan" Basal-notched style that occurs on Arroyo is present within the Virgin culture area by Pueblo I times, dominant during Early Pueblo II, and continues into Late Pueblo II/III times.

The geographic range of Bull Creek points spans the uplands of the Grand Staircase and the Arizona Strip. As Walling-Frank points out in this volume, they are noticeably reduced in number in the St. George Basin, and do not seem to be reported at all in the lower Virgin River drainage in Nevada. South of the Colorado River they are the dominant type on Kayenta sites during Pueblo II and Pueblo III times (Geib 2001). The ratio of Parowan Basal-notched to Bull Creek projectile points recovered at Arroyo was seven to four (Fig.7.1).

For the purposes of identifying cultural diagnostics, it is sufficient to say that the Parowan style occurs in the Virgin Early PII - PIII and spans the cultural area from St. George to the eastern Grand Staircase. Over that area the Bull Creek form appears no earlier than A.D.1050/70, but occurs prior to that date in the Kayenta area. It appears that the temporal and geographic distribution of the Bull Creek type is strongly associated with the introduction of other late Pueblo II material culture traits.

Walling-Frank points out in Chapter 6, that there appeared to be no "spatial/areal differentiation in the distribution" of Parowan and Bull Creek points on the Arroyo site. All of the points were found in fill or midden contexts. If the mix of Virgin basal/corner notched types and the introduced Bull Creek style is taken as a textual statement on the groups who created them, the evidence supports the scenario of actual migration of Kayenta culture bearers into the Kitchen Corral Wash area. A more nuanced interpretation of this ambiguous phenomena considers projectile points as just one exotic trait among many that were selectively "accepted" by the indigenous Virgin population.

Spindle Whorls

In Chapter 6 Van Alfen describes the formal characteristics of ceramic disks, including perforated disks, generally referred to as spindle whorls. This section reviews the temporal range and geographic distribution of spindle whorls in the Virgin region and their association with the production of cotton yarn.

Cotton fiber, yarn or cloth has rarely been reported from Virgin sites. This is probably a result of poor preservation on open sites and limited excavation in sheltered sites. Perforated ceramic disks, however, are known to occur with some frequency on open, late Pueblo II sites. Neff (1996) has made a convincing case for the production of cotton yarn using spindle whorls during the late Pueblo II period in the Kayenta region.

There is little evidence for growing cotton in the fossil pollen record in the Virgin culture area. In support of the presence of cotton at 42Ka3976, Cummings (Chapter 11) reports a single grain of cotton pollen from the floor of Pit Structure 2 (Fig.11.1). Whether this pollen represents the presence of actual cotton plants, or raw cotton, is unknown. What is clear is that spindle whorls were manufactured on site as evidenced by: roughed out ceramic disks, disks that were ground but lack perforations, disks with partially drilled holes, and disks with completed perforations (Figs.6.4,6.5). The sheer number of these artifacts at Arroyo underscores their importance.

A limited review of the temporal and spatial distribution of spindle whorls in the Virgin culture

area indicates they are found almost exclusively during late Pueblo II times and seem to be most common in the uplands. Cotton's requirement for a relatively long growing season of 180-200 days (Neff 1996) and its demand for substantial amounts of water could easily have been met in the St. George Basin; historically, "Dixie" was known for its cotton production. At present there is little, if any, evidence for prehistoric cotton farming in the St. George Basin.

Somewhat at odds with the temporal placement of spindle whorls as solely late Pueblo II artifacts are the St George Black-on-gray designs on found on several (Figure 6.4; FS45, 259). While this is an early Pueblo II ceramic type, all of the spindle whorls were found in late Pueblo II contexts. This suggests that these specimens were created from either curated vessel fragments or, more likely, sherds found in midden deposits.

The temporal and geographical distribution of spindle whorls in the Virgin culture area appears to be similar to that for Bull Creek projectile points and deep pit structures. This suggests that all three traits were inspired during late Pueblo II times by what has been called the "Kayenta intrusion" (Lyneis 1996).

SUBSISTENCE

Data on subsistence and diet preceding the Arroyo site occupation (A.D.700-1050) indicate that native flora and fauna contributed, at least at times, significantly to diet on the Grand Staircase. Local sources of macro floral and faunal data include: Dead Raven (Walling and Thompson 2004), the Kanab site (Nickens and Kavamme 1983), the Park Wash site (Ahlstrom 2000), and the EFN Vermilion Cliffs project (Westfall 1985). These excavations provide a baseline for describing subsistence practices through time, and also comment on the availability of different types of game. Pollen analyses at these sites provide data on the relative importance of domesticated versus native economic types, as well as the pollen spectrum present in the natural environment. A consistency worth noting is the presence of cattail pollen (*Typha*) on the Arroyo site, as well as earlier sites along Kitchen Corral Wash. This potential food source also suggests a stable riparian zone, and perhaps a lack of arroyo down-cutting, during periods of occupation.

Scrap animal bone on Arroyo was abundant and well-preserved; Artiodactyl remains were especially well-represented. This is in marked contrast to sites in the St. George Basin where Dalley and McFadden (1985; 1988) encountered very little bone and concluded that game was not an important part of subsistence on those particular sites. The Arroyo site is situated along a major mule deer migration route and is advantageously positioned to exploit several different habitats suitable for mule deer, sheep, and pronghorn.

Discussion

Game procurement strategies and the degree of reliance on domestic versus wild foodstuffs were issues addressed in the Arroyo site research design (Chapter 2). It was assumed that the low incidence of Anasazi hunting camps in the higher elevations of the Grand Staircase, as well as other areas outside the favored agricultural zone, suggested that game was procured locally rather than through a series of logistically organized hunting camps. The identifiable faunal assemblage recovered at Arroyo was dominated by deer, mountain sheep, pronghorn, cottontails and jackrabbits. Cut marks on the ungulate bone suggested to the faunal analyst that entire carcasses were being brought directly to the site. This supports the observation that Virgin settlement, i.e. the distribution of different types of sites over the landscape, was focused on agriculture, with procurement of game a secondary or even incidental consideration.

The degree of reliance on domestic versus wild foodstuffs, although related to the above, is a more complex issue to resolve. As noted, reliance on game in the Virgin region appears to have varied geographically – probably in response to the availability of game. Certainly, the availability of game could have varied through time as well, although this seems not to have occurred in most areas. Again, if hunting was more important during certain periods, we would expect to see an increase in hunting camps in the surrounding areas - this does not seem to be the case, at least in the Kitchen Corral vicinity. Throughout the Formative Period, Virgin settlement patterns and subsistence strategies appear to have changed very little.

Martin's macrobotanical analysis (Chapter 10) of seeds from the floor surfaces, hearths, and room fill supports the apparent heavy reliance on maize by Arroyo inhabitants. Maize was the most ubiquitous taxon recovered, followed by weedy annuals that likely grew in the fields. Cummings' pollen analysis (Chapter 11) reinforces the argument that Arroyo inhabitants relied heavily on agriculture. Maize and squash (or pumpkin) pollen was recovered from room floors as well as midden contexts. While a variety of wild plant pollen, including beeweed, Mormon tea, grasses, cholla, buffalo berry, wild carrot and globe mallow was recovered, it seems unlikely that the bulk of calories at Arroyo were derived from wild plants, although they may have been important for their nutrients and medicinal purposes.

Recently Martin (1999) reported the results of a stable carbon and nitrogen isotope ratio analysis on individuals from the Arroyo site as part of a larger study of Virgin culture area subsistence (Martin 1999). Martin concluded that wild plants and animals were consumed, but they were not a significant source of annual calories. One finding of interest was that even the dogs at Arroyo were consuming large quantities of maize. Clearly, maize was a major component of diet for all of the inhabitants of the Arroyo site!

Referring to Martin's study Ahlstrom (2000) pointed out that since the isotopes in bone collagen reflect information on diet averaged over a period of years, the technique is not sensitive enough to comment on how the Anasazi responded to short-term variability, i.e. shortfalls of maize due to crop failure. He goes on to ask "whether such shortfalls occurred often enough to have had a significant effect on the Virgin Branch adaptation" (Alhstrom 2000:128). This is an important question; Ahlstrom assumes that the probable Virgin Anasazi response to crop failure would be to fall back on wild plants and animals. As pointed out above, if this were the case we would expect higher frequencies of limited activity sites in the surrounding area. What does seem to be reflected in the excavation and settlement data, is short-term residential mobility from one pueblo to another. Presumably this was a response to crop failure and moving on to better farming locales. Admittedly, shifting residences periodically would also have opened up new sources of wild foodstuffs.

Midden: It's Not Just Trash

Of the thousands of artifacts recovered from the Arroyo site excavations, only a handful were found in their primary contexts – over 99% were part of trash deposits located in the fill of the pit structures. The fact that artifacts were found in midden deposits rather than in their primary contexts, however, does not mean that that their disposal wasn't purposeful, culturally prescribed behavior.

Trash deposits are commonly found in the fill of Virgin pithouses from Basketmaker III times through late Pueblo II. For the excavator this is a fortunate situation: it allows perishables to be quickly buried thus enhancing preservation, concentrates the recovery of sensitive artifacts, and orders them in stratigraphically sequenced deposits. What these intentional deposits meant to the prehistoric inhabitants is speculative. What is apparent is that these locations were considered appropriate repositories for objects valued by the inhabitants, including carefully interred burials.

From the perspective of modern interpretation this behavior – that occurred for whatever reason, relates significant information to the excavator and the overall interpretation of the site. It has been observed for some time that middens on late Pueblo II (A.D.1050-1150) Virgin sites on the eastern Grand Staircase can be extremely heavy, even on relatively small sites. Yet, based on cross-dating, the ceramics in them don't date beyond about A.D. 1150. How did such huge deposits develop in such a short period of time? Two explanations are offered: 1) Based on recent radiocarbon dates, the sites were actually occupied much longer than previously thought; as late as A.D.1250 or longer, 2) Patterns of site-use involved episodes of occupation and "fallow" periods that resulted in the abandonment of pitstructures after relatively short periods. Reoccupation involved construction of new pit structures and the remodeling and expansion of the existing roomblock. Construction debris and trash from these activities appears to have created larger than normal volumes of trash.

Mortuary Practices and Processes

The initial recording of the Arroyo site documented an interment eroding out of the wash bank (Fig.3.1; Burial 1). Subsequent excavations

encountered additional burials as well as isolated human bone. The excavation of human burials on an archaeological site is a sensitive issue - particularly with Native American groups. In the past, burials were excavated in order to provide data on aspects of culture such as ceramic chronology (Beals, Brainerd, and Smith 1945). More recently, the excavation of human remains is generally not by intention, but rather a matter of accidental encounters or salvaging remains from a threatening situation. Sensitive though they might be, failure to report them fully would not only be a tremendous loss of data, but also a serious breach of ethics.

Mortuary practices of one sort or another are a universal aspect of human behavior. While the disposition of human remains is a sensitive issue; they are a legitimate source of data. These practices and patterns, viewed in the larger context of a group's adaptive strategy, have the potential to provide valuable insight into how this social practice was integrated into a larger socio-economic pattern; this is particularly true in the Virgin culture area.

Data on human burials in the Virgin culture area are scarce (Roberts 1997). Considerations of mortuary practices are even rarer (but see Lyneis 1992). Data on burials during the Basketmaker III-early Pueblo II period in the Virgin culture area is minimal, and as yet does not seem to conform to an identifiable pattern. During the late Pueblo II period burial practices are better known; interments are usually located in open areas to the southeast of the roomblock, in midden deposits or, in the fill of pithouses.

As part of a group's interrelated cultural behavior, mortuary practices, like any culturally prescribed behavior, not only must be in accord with the group's basic adaptive strategy, but may actually reflect aspects of it. For example, burial of family members on a site may reinforce and legitimize land tenure by a lineage. This could be important if residential mobility, i.e. moving among a series of farmsteads as conditions required, was a common practice. If residential mobility was a strategy, the question might be asked: was one residential site preferred over another for burial?

Human remains were found in three different contexts at Arroyo: 1) primary interments, 2) a secondary interment, and 3) isolated and scattered remains. None of these patterns are considered random. The primary and secondary burials were intentional, the scattered remains appear to be the consequences of an unintentional process. The fact that the scattered remains are so widely dispersed reinforces the proposed model of episodes of site abandonment and reoccupation; i.e. the excavation of new pit structures, particularly in the midden area, had the potential to inadvertently encounter previously interred individuals. The secondary interment of Burial 3 allows a special insight; the cranium along with parts of the post-cranial skeleton contained within it, were carefully interred along with 5 vessels in the fill of Pit Structure 1. A reasonable explanation for this phenomena is that the remains that were initially interred elsewhere on site, were disturbed through new construction and subsequently reburied.

Another possibility for the scattered nature of the remains is that they are the result of some sort of violence as suggested by Turner and Turner (1999): no abnormal breaks, cut marks or burning were observed on the Arroyo remains that suggest foul play. There were, however, indications of stress due to malnutrition: the majority of the remains were those of infants and young children suggesting that life could be hard during late Pueblo II times, particularly on the young.

SUMMARY AND DISCUSSION

Aikens (1967) considered the "Pueblo II expansion" in the Virgin culture area to be the result of a period of in situ population growth and movement into previously unoccupied areas. Based on ceramic cross-dating it appeared that by A.D. 1150 the Virgin subculture had ceased to exist. He suggested that "they moved southeastward to join their relatives in the Kayenta region (Aikens 1966:55, 56). Since Aikens wrote, nearly forty years ago, a good deal of data has accumulated with which to address the issues of chronology, ethnicity, demography and the nature of Virgin population movement.

Ethnicity

Aikens (1967) saw the Virgin and Kayenta as becoming separate socio-cultural entities by A.D.

900. Geib (1996) has a similar perspective for the relationship between the Fremont and Kayenta in the Escalante River drainage. The view taken here is similar except for the dating: shaped by geographic separation and the development of a unique adaptive behavior, an ethnic frontier developed between the Virgin and Kayenta culture areas by Basketmaker III times and perhaps earlier. The archaeological record on the Grand Staircase demonstrates the lengthy continuity of both material culture traits and settlement patterns that reflect this basic Virgin adaptation.

Sometime during the Pueblo II period, between A.D. 1050 and A.D.1100, this frontier appears to break down. The architectural and ceramic changes that occurred at this time have been called the "Kayenta intrusion" (Lyneis 1995). As shown throughout this report, the post A.D. 1150 occupation of the Arroyo site displays a mix of Virgin and Kayenta stylistic traits. In fact, the mix of Virgin and Kayenta artifact and stylistic traits after A.D.1050/1100 varies across the Virgin region. Apparently this is due to processes involving actual contact in the east, giving way to trade and emulation further west. When viewed as part of an indigenous local adaptation that relied on residential mobility and the serial reoccupation of sites, it is argued, the ambiguity of the Arroyo site data is resolved: artifacts and architectural types and styles, while inspired by the Kayenta, were modified to accommodate the indigenous Virgin inhabitants.

While radiocarbon dates at Arroyo indicate a significant occupation well into the 13th century, no Kayenta series Pueblo III ceramics typical of the period were encountered. This suggests that Virgin contact with the Kayenta did not occur after about A.D.1150. If this is the case, the "Kayenta Intrusion" may be viewed as a relatively short-lived late Pueblo II phenomena that occurred sometime during the period A.D.1050 to A.D.1150. The lack of Kayenta Pueblo III pottery, and the aberrant drift of designs on local pottery, suggests that after A.D. 1150 contact with the Kayenta south of the Colorado River ceased.

Demography

Accompanying the introduction of foreign material culture traits, particularly evident on the eastern Grand Staircase, is a dramatic increase in population during the late Pueblo II period (McFadden 1996: Table 4). Based on the inventory of 381 sites in the Seaman Wash and Fin Little drainages, counts of Late Pueblo II architectural sites increased better than two-fold over the earlier period. This could be due to: 1) rapid internal growth as Aikens (1967) suggested, 2) population movement within the Virgin area, 3) immigration of new groups from the Kayenta area. Internal growth probably did occur, but it seems unlikely to have accounted for such a rapid rate of increase. There is also some evidence for internal population movement: near the western edge of the Grand Staircase on Little Creek Mountain site counts suggest a modest decline in Pueblo II population over the previous period (Heid 1982; Wise 1986); the upper Virgin River drainage was essentially depopulated by A.D. 1100 (McFadden 1996:Fig.5). Even allowing for these potential internal sources of growth, and the evidence for ethnic intrusion, at least part of the apparent expansion during late Pueblo II on the Grand Staircase may have been due to a different process, the intermittent occupation of multiple farmsteads by a single family or group.

Virgin Adaptive Behavior

A scenario that accounts well for both the material and behavioral aspects of culture described in this report, i.e., the curious blend of Virgin and Kayentan artifact and architectural styles and the propensity for Virgin populations to periodically shift among residences, considers the Arroyo site, as well as the eastern Grand Staircase district, as participants in a social and economic organization that spanned most, if not all, of the eastern Arizona Strip and south-central Utah. The extent of this relationship is best defined by the distribution of Shinarump Gray Ware or Shinarump-like pottery, over most of this area. Shinarump Gray Ware appears to have originated on the Grand Staircase. It occurs in the Kitchen Corral drainage as early as Basketmaker III times (Perry 2000). This suggests the ware spread from Virgin territory on the Grand Staircase south to the eastern Arizona Strip.

Contrary to conventional wisdom that cultural influences flowed only from east to west in the region, the transmission of artifacts, ideas and people appears to have been a two-way relationship - not simply one

of Kayenta influences pushing west, but also Virgin population movement south and east to the Arizona Strip. A good example of this interaction is a cluster of pueblos and agricultural features focused on an alluvial outwash fan in House Rock Valley. There, typical Virgin style accretionally constructed pueblos occur alongside formal "L" shaped unit pueblos with "kiva" depressions (McFadden 2004). Both pueblo types display similar Late Pueblo II ceramic assemblages with Shinarump Gray, Red and White Wares dominating. While formal unit pueblos also occur in Kitchen Corral Wash and are found as far east as the Coombs site (Lister 1959) and as far west as Short Creek (Frank and Thompson 1995), their highest density and probable origin is on the eastern Arizona Strip. The fully-subterranean pit structures on these sites, as at the Arroyo site, appear to have functioned as domiciles rather than kivas. Because these site layouts are not found east of the Colorado River (Phil Geib 2002 personal communication) they appear to represent Virgin emulation of style rather than the actual presence of Kayenta people.

The field houses, agricultural terraces and check dams that are intermixed with these pueblos probably did have their origins in the Kayenta region. While they are common in House Rock Valley and Saddle Mt., it is notable that they have not been identified in the Kitchen Corral drainage. Their occurrence on the eastern Arizona Strip and apparent absence on the Grand Staircase is problematic, but appears to be the result of adaptation to local agricultural requirements and settings; agriculture along Kitchen Corral Wash simply didn't require these techniques. Describing the Virgin Anasazi in terms of behavior inferred from the archaeological record, rather than viewing artifacts and architecture as representing distinct "ethic" groups largely side-steps the issue of when, where, and if Kayenta immigration occurred. Probably it did occur on the level of small groups traversing the Colorado Plateau as has been proposed (Bernadini 2005). It is also likely their impact was greatest on the eastern margins of the Virgin region but in the perspective developed here, by late Pueblo II times, the indigenous population of the eastern Grand Staircase, including the Arroyo site occupants, were not simply the passive recipients of Kayenta influence, but were equal participants in a reciprocal social and economic relationship that spanned the eastern Virgin region.

The Arroyo site and the eastern Grand Staircase were occupied well into the 13th century. By the end of the century the region was depopulated. If the Virgin Anasazi did in fact rely on a system of periodic shifting among multiple residences, increases in population on the Grand Staircase could have had the effect of pressuring both indigenous and new arrivals to occupy normally "fallow" sites. During a period of optimal climatic conditions, this may not have been a problem. However, in conjunction with a Colorado Plateau-wide climatic downturn around A.D.1270 (Benson and Berry 2009), this situation could have stressed the long-established system that depended on a stable population and the ability to shift among multiple agricultural options. Ultimately, overextension of the Virgin agricultural strategy that had been practiced since Basketmaker times, in combination with climate deterioration, may have led to collapse of the subsistence economy and rapid depopulation of the Grand Staircase during the 13th century.

Epilogue:
The Grand Staircase–Escalante National Monument Kanab Visitor Center Concept

BY
Douglas A. McFadden
and Carolyn Z. Shelton

The Archaeological Concept

Established in 1996, Grand Staircase-Escalante National Monument (GSENM), the first national monument managed by the Bureau of Land Management, embodies a unique mission: the pursuit of science through research and education in its vast, two million acre outdoor laboratory.

At the Kanab Visitor Center, carefully planned archaeological exhibits draw visitors into the world of archaeology. A dramatic backdrop sets the stage for learning about the systematic processes of this science: excavation, analysis, and interpretation.

Exhibits were designed by an interdisciplinary team consisting of an exhibit designer, exhibit fabricator, writer, archaeologist, interpretive specialist, artist, and educator. The team worked to develop exhibits that would be intriguing for visitors, yet substantially educational for students. The exhibits would also need to provide a foundation of learning for teachers and interpretive staff to use in the development of programs. Each specialist brought their particular perspective to the project, and the final exhibits clearly show their diverse expertise.

The Excavation Diorama

Almost from the beginning, the team agreed the central focus of the archaeological exhibit would be an excavation. This required selection of a site that involved the principle investigator as technical advisor.

We considered two sites. The Road Kill Site was under excavation at the time and was the first choice of the team. Road Kill (named after its location within the Kitchen Corral road) was a visually impressive site, but the report remained to be written. More important, it lacked depth, complexity and the variety of architecture necessary to use it for instruction.

The Arroyo site had been excavated, backfilled, and was partially written up. Plan and profile drawings were completed and numerous photos available to provide the exhibit contractor adequate detailed information to fabricate an excavation reconstruction. The site was deep, complex, and had been excavated in a rather unique manner. Even more important, its interpretation offered a chance to illustrate a wide variety of relationships between artifacts and their context in the site, between the several different types of architecture present, and

between the site and its social and environmental settings. In addition, Arroyo seemed to offer the best opportunity to instruct students of all ages in the methods and techniques of archaeology. Field tours of the site during its excavation in 1994 had proven to be an excellent and effective educational experience for visitors (Fig.13.1).

Having selected an actual excavation as the central focus of the exhibit, the general concept of "context" seemed to be a natural choice for a theme. While museums typically focus on artifacts themselves, we would emphasize the importance of where artifacts were found, their relationships, and what they can tell us about prehistoric life and behavior. A second, but equally important message concerning context relates to looting and illicit collecting. Pot holes in a site obviously disturb the context of artifacts and deposits; by the same token, surface collecting of sherds or projectile points can alter the temporal context of a site – particularly one with only a surface component. In several places, text on panels reminds the reader about the importance and legality of leaving artifacts where found.

THE SCIENCE

Rather than share with visitors and students everything we know about the Arroyo site, our goal is to introduce the viewer to portions of a "virtual" site, then guide them through some of the science involved in figuring out how the excavated features relate to one another and what they can tell us about the behavior of the people who lived there. Our goal is not simply to instruct about what we have learned, but to evoke a curiosity about how we learned it. Two themes emerged from this approach:

1) There is much we still do not know about this particular site – this is also true of archaeology on GSENM, as well as the region in general.

2) Using the scientific method, we can describe and catalog the artifacts and features excavated, raise questions about them, and then develop hypotheses about the activities that took place on site.

Theme number one is especially critical to the student, as it acknowledges that there is much yet to be learned and discovered, and thus, that there is possibly a role for them to play in the future –

Figure 13.1. Utah Prehistory Week school children above Excavation Unit B (courtesy of Southern Utah News).

particularly in developing new concepts and avenues for pursuing knowledge. Theme number two lays the groundwork for the actual exhibits, whereby we show the viewer a reconstruction of part of an actual excavation, describe excavation techniques, explain how we analyze artifacts, date the features and develop chronologies, and finally how we draw our inferences and conclusions. These inferences are then translated into a mural showing various activities, abstracted from the archaeological record, that may have taken place at the site nearly a millennium ago.

THE EXCAVATION DIORAMA

The excavation mockup is a near full-scale model of excavation units C and D at the Arroyo site (Fig. 3.1). These units were located near each other and therefore the display could easily depict their spatial and stratigraphic relationships, as recently exposed, in the bank of the arroyo. Each excavation unit held a unique pit structure that could be represented. Excavation Unit D held Pit Structure 2, a large, deep structure with well-defined floor features. Excavation Unit C held the nearly complete, "mini" Pit Structure 3. Further, since the fill of Pit Structure 2 had not been completely excavated, the remaining profile of midden deposit, which included a variety of trash and artifacts, could be used to illustrate its post-occupational use as a trash dump (Figs. 3.36; 3.37). Finally, the overlying deposits (Strata 1 and 2) that sealed both excavation units, could illustrate the structure's common "level of origin" (and therefore their association in time), as well as represent the final event which buried the site.

The display was fabricated by Acme Studios of Portland Oregon. Scaled drawings of the excavation units, in both plan and profile, were provided for the 3-D model. The framework, which measures 22 ft wide by 7 ft deep and is 8 ft high, was constructed of metal supports with plywood surfaces and then temporarily covered with paper to assist in visualizing the model (Fig. 13.2 and 13.3).

The framework was covered with hard foam, sculpted and carved by hand, then coated with a layer of concrete stucco. Following extensive reviews by archaeologist McFadden at each stage of development, the contractor proceeded to paint the model as true to life as possible. Along with numerous photographs, samples of dirt from the site provided the artists with accurate colors. Actual pieces of jacal; animal bone, non-provenienced artifacts including, ceramic sherds, lithic flakes; and local sandstone and vegetation, all added to authenticity (Figs. 13.4 and 13.5).

Embedded into the excavation diorama are three exhibit cases which introduce the viewer to the various techniques of excavation and dating analysis (Figs. 13.7 - 13.9). It is equally as important to understand the processes and procedures used to reach our interpretations and conclusions as are the results themselves.

Figure 13.2. Reconstruction of Pit Structures 2 and 3 covered in paper

Figure 13.3. Reconstruction of Pit Structures 2 and 3 covered with concrete stucco.

Figure 13.4. Completed diorama of Pit Structure 2.

Figure 13.5. Completed diorama of Pit Structure 3.

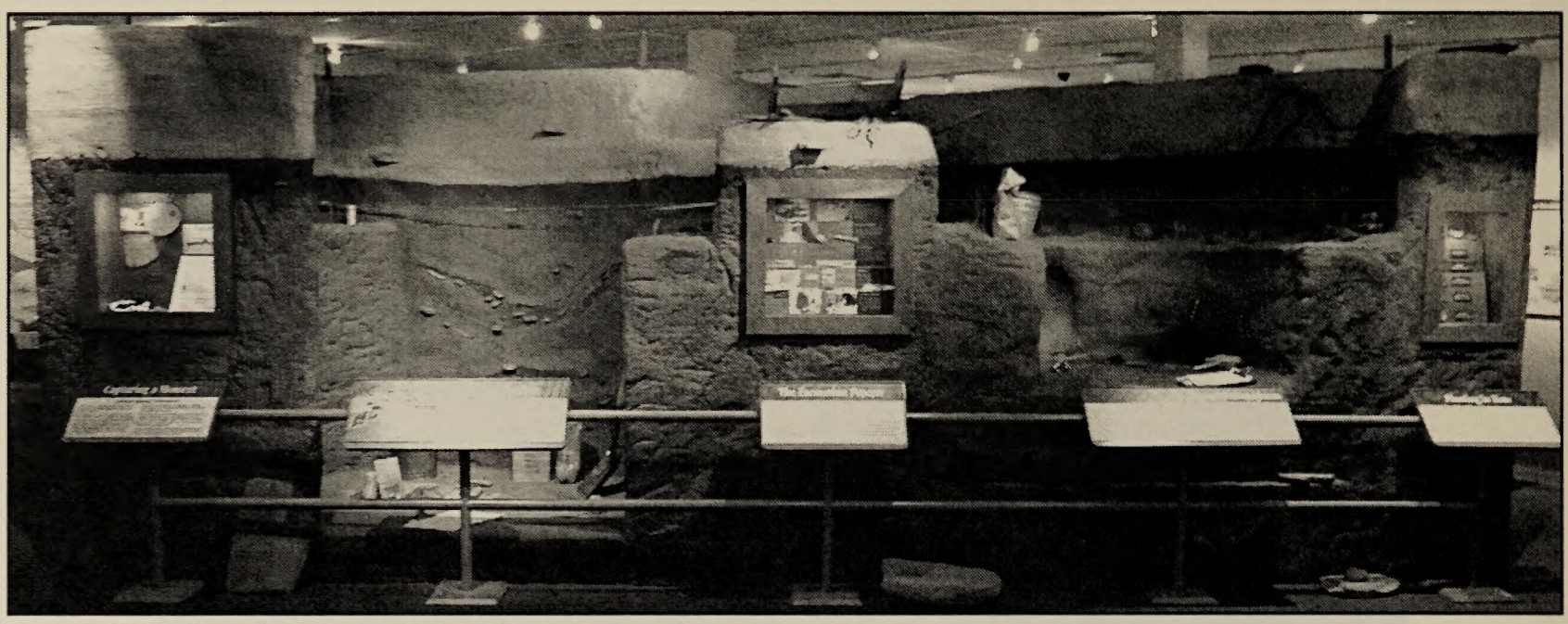


Figure 13.6. Completed excavation diorama

Figure 13.7. Photographs and captions describe how archaeologists use the most appropriate tool for each job on the excavation - from backhoes and shovels to dental picks and tiny brushes. Once samples are collected, they are tested. Soil samples undergo flotation tests which may reveal tiny fragments of bone and seed. These, in turn, help archaeologists reconstruct the diet of prehistoric peoples. Microscopic pollen samples identify domesticated crops and native plants - all to provide a better picture of the surrounding environment.

Figure 13.8. In a vertical sequence of soil deposits, objects found in the lowest layers are older than those found in the deposits above. This principle of superposition, as used by archaeologists, is a relative dating technique. In the exhibit, a sequence of prehistoic pottery types are arranged in temporal sequence with the oldest prehistoric sherds on the bottom and the broken rim of a historic glass bottle on the surface.

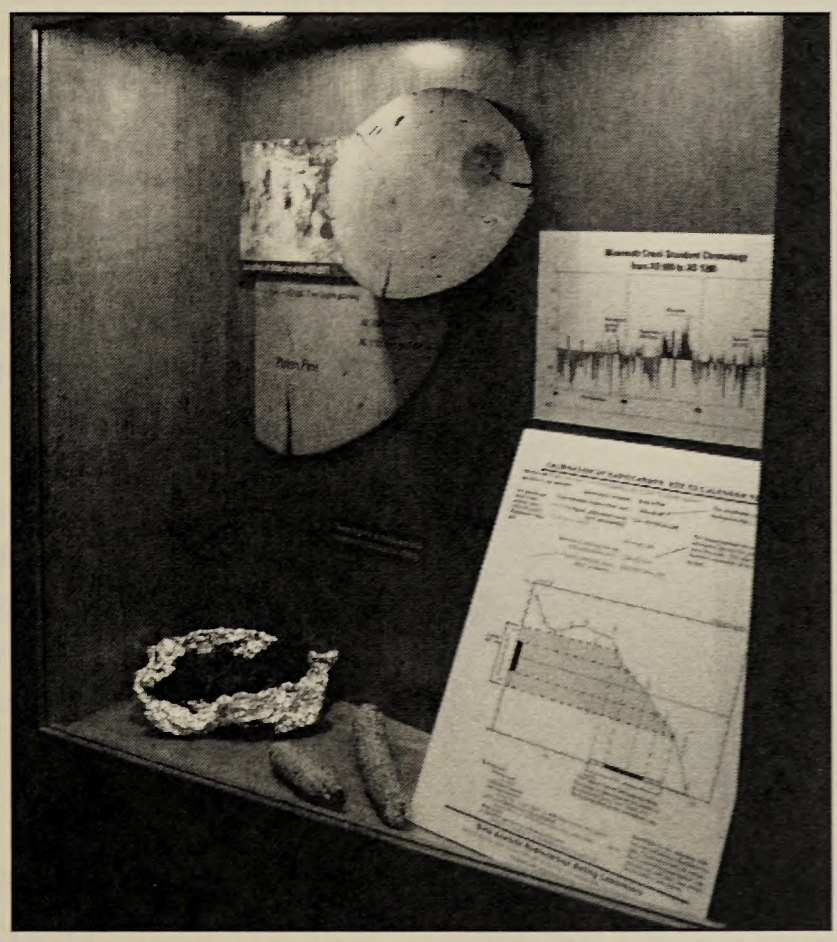


Figure 13.9. Absolute dating techniques are described in this case. Dendrochronology, or tree-ring dating, is used to determine when ancient timbers on a site were cut, and by inference, when they were used for construction. Radiocarbon dating measures C14 carbon isotope levels in organic materials such as bone, plant material, shell, wood, and charcoal. C-14 assays provide an age for the samples and thereby date associated artifacts and features.

ADDITIONAL EXHIBIT CASES (Figs. 13.10 - 13.11)

Figure 13.10. This case illustrates activities that ancient people may have participated in. On display is a rare hand-plaited rabbit net and a snare made of perishable native fibers. Accompanying the artifacts are artist sketches that depict how we believe they were used.

Figure 13.11. We have several display cases prepared for changing exhibits that give us the opportunity to share locally recovered artifacts and stories with the public. This display shows a collection of bone awls and a well-preserved example of basketry.

THE MURAL, CIRCA 1100 AD

The "Day in the Life" mural was inspired by a sketch of the Coombs Site in Boulder, Utah (Lister 1959). This descriptive technique would interpret behaviors that occurred on and around the Arroyo site based on the actual archaeological record. It is a visualization of this record and seems to work for students of all ages; young children and students can understand it, while scholars can consider in greater depth what activities took place on the site (Fig. 13.12).

Interpretive artist Linda Feltner traveled to the Arroyo site – pencil, paints, and sketchbook in hand. Together, with archaeologist Doug McFadden, the two collaborated to create the ancient village site in a three-dimensional perspective painting. The image painstakingly recreates the physical locations of dwellings, pit structures, storage rooms, middens, and hearths, as they were found by the archaeological excavation crew.

In addition, the painting depicts the Anasazi (or Ancestral Puebloan) people engaged in various activities relevant to the time and place. Through inference of use, the artist painted each relevant activity represented by artifacts found at the Arroyo site. For example, based on bighorn sheep bone found in the midden, we presume that the people hunted and ate bighorn sheep meat. In the painting, artist Feltner depicts two hunters returning from the hunt with a dead bighorn sheep for the people to feast upon.

An interpretive panel accompanying the mural cites the archaeological evidence for the behavior inference depicted in the mural (Table 13.1). In this fashion, the link between the artistic rendering of everyday life and the archaeological record is clearly established –both literally and figuratively. Each activity shown in the mural is, in fact, a topic that visitor center staff or educators, using the GSENM educational curriculum, can draw upon for delivering programs to students and the general public.

THE ARCHAEOLOGICAL TIME-LINE

Although the temporal framework of puebloan prehistory is well known, it is the local record that

Figure 13.12. Photograph of mural "A Day in the Life."

intrigues citizens of south-central Utah. In a very real sense - all archaeology is local. The GSENM time line (Fig.13.13) delineates a 10,000 year old chronology based on local artifact cross-dating, radiocarbon dates, and tree-ring dating (McFadden 2000a). The display provides a visual graphic of contextual associations for four categories of material culture – vessels (basketry and ceramic), artifact technology (projectile points and tools, ground stone), architecture (storage and residential), and rock art (pictographs and petroglyphs). These categories are arranged vertically to show their association with one another, and horizontally to illustrate their temporal placement in calendar years and within a cultural phase system.

Two aspects of the GSENM timeline are unique. First, the timeline is based on local sites - most of which are found on the Monument. Second, artifacts and feature illustrations are identified by their Smithsonian tri-nominal site number where possible. This conveys to the viewer not only the general location of the site (eg. Kane County, Garfield County et cetera), but also that it has been formally documented in a site form or technical report.

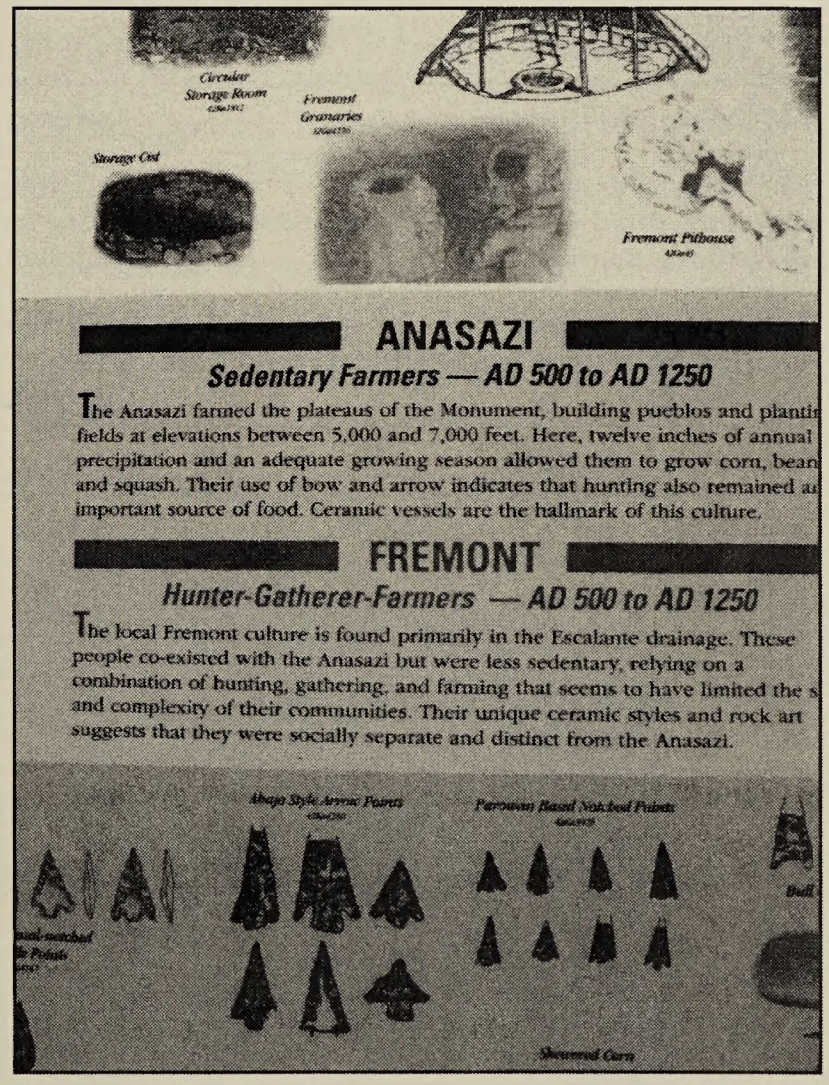


Figure 13.13. Time-line.

THE CERAMIC SEQUENCE

Stressing the uniqueness of the local archaeological record, a display of ceramic vessels illustrates the sequence of types and styles found in the Monument area (Fig.13.14). The display showcases a 700 year developmental sequence of local Anasazi ceramic types ranging from Basket Maker III (AD 500) period through to Late Pueblo

	Behavioral Inference	Archaeological Evidence
1	"Flintknapping"	presence of stone tools, chipping debris
2	Timber stockpile	roof and wall construction
3	Gathering firewood	presence of hearths
4	Pit structure (winter use?)	excavated (Feature 11)
5	Semi-subterranean room (use?)	excavated (Feature 10)
6	Obtaining drinking water	spring, 1 kilometer
7	Domesticated turkey	scrap turkey bone in midden
8	De-vegetated slopes	hearths and roof/wall construction
9	Wattle and daub storeroom (jacal)	fired clay and charcoal, sealed flagstone floor
10	Drying corn prior to storage	corncobs, kernels, maize pollen; storerooms
11	Rebuilt storage rooms	multiple floors (excavation)
12	Rebuilt surface residential room	superimposed hearths, multiple floors (excavation)
13	Abandoned pit structure	trash fill (excavation)
14	Open air kiln	presence of pottery
15	Ramada, activity area	post holes, hearth, occupation surface (in arroyo profile)
16	Milling maize	presence of manos and metates
17	Big game hunting	scrap bone in midden (deer, antelope, sheep)
18	Pet dogs	buried dog skeleton
19	Cleanup activities	layers of domestic trash in midden
20	Music	presence of flutes
21	Children playing	vigorous population
22	Neighbors	nearby site with similar ceramics
23	Setting a snare	small game in midden deposits
24	Alluvial outwash farming	proximity of catchments, wash and alluvium; rainfall pattern
25	Repairing downcuts	inferred from setting
26	Agricultural fields	presence of maize in deposits, pollen
27	Ancestors	early sites nearby
28	Native foods	wild seeds, pollen, macro-floral analysis

Table13.1. Behaviors portrayed in the Arroyo site Mural.

II (AD+1150). Looking closely, the visitor can detect changes in rim form and vessel shape, see painted designs evolve, and new wares emerge.

THE MOTHER OF ALL MAP MODELS, OR... THE CARTOGRAPHIC WONDER

Employing advanced cartographic design and fabrication techniques, a 6'x6', three-dimensional tabletop terrain model (Fig. 13.15) provides a unique perspective to viewing the topography of a 32,300 square kilometer area (1 cm = 1 k). The surface of the model is actually a satellite image of the region, photographed by Landsat 7,438 miles above the earth's surface. The photograph was digitally reproduced and molded on top of a computer generated and carved, 3-D high-density, foam product, then sealed with a durable protective coating.

The model gives visitors and students a real-life, full-color view of the landscape, providing a way to consider how the geographic context influenced the life and movements of ancient peoples. Seeing the mountain ranges, limited waterways, deep canyons, and vast deserts help explain why certain areas served as farmland, transportation corridors, or barriers to travel and settlement.

EDUCATIONAL PROGRAMMING

We are developing curriculum modules based upon thematic exhibits in the visitor center. They will be available to teachers on CD-Rom, with a web-based version in the near future. Our initial target audiences are:

1) third and fourth grade elementary level students,

2) high school students, and

3) college students visiting the Monument on field trips.

For students who tour the visitor center, the modules will provide pre- and post-visit classroom activities. For those who are too distant, the curriculum provides a vicarious visitor center visit, describing and showing each exhibit. A large classroom poster-sized version (2' x 6') of the archaeological timeline will be available on a rental basis as part of the classroom archaeological module.

Additional activities we hope to develop include teacher training workshops and a field trip component. Another possibility would be a Monument archaeological laboratory where students could perform various experiments, including such activities as an excavation sandbox or a glass pit house that illustrates the sequence of events from construction to abandonment and subsequent burning.

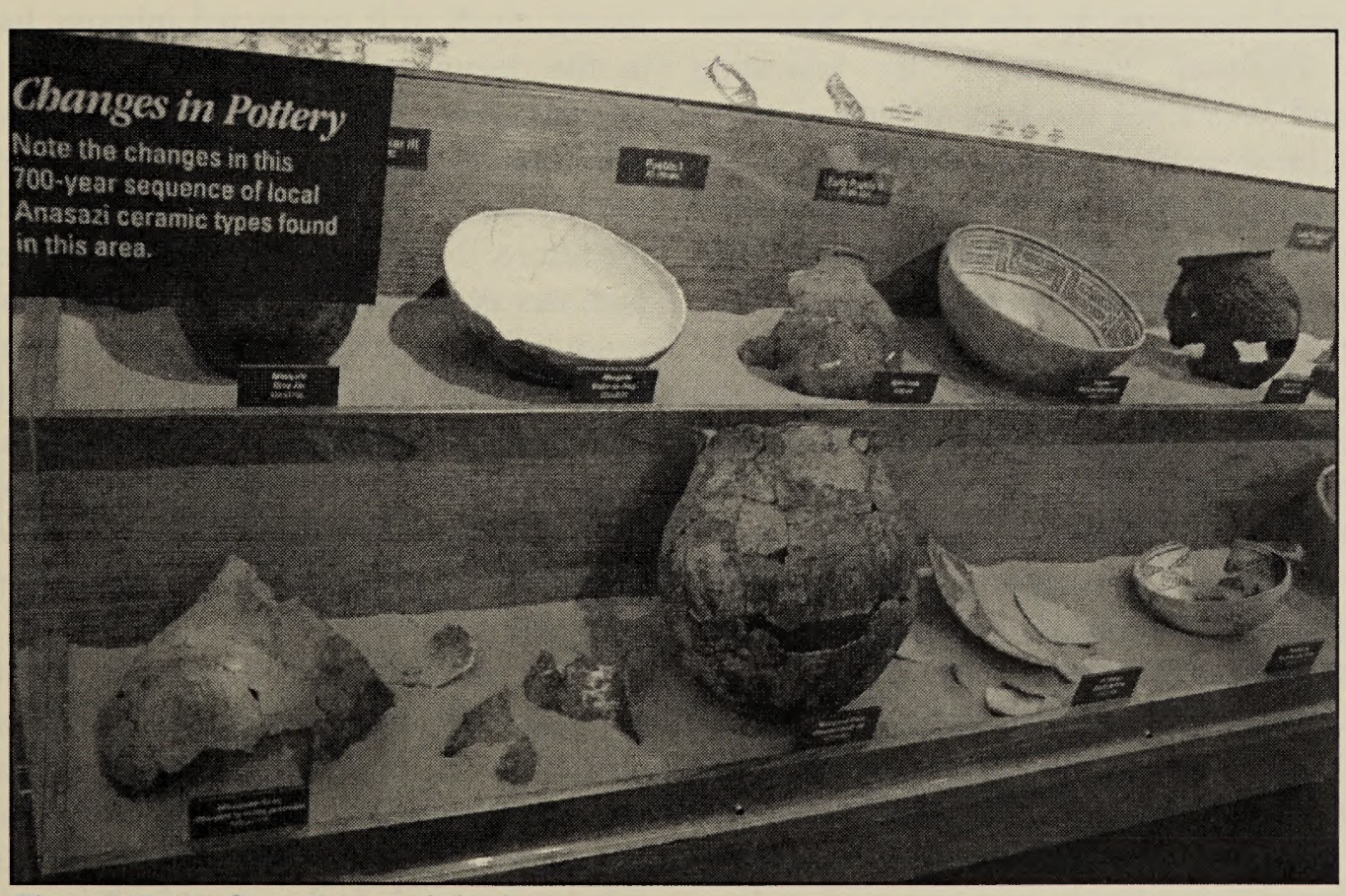


Figure 13.14. Ceramic vessel display.

Figure 13.15. Three-dimensional tabletop terrain model.

SUMMARY

This Epilogue describes how we laid the foundation for a beneficial relationship between the archaeological and interpretive professions which will, hopefully, result in enhanced protection of archaeological resources on the Grand Staircase-Escalante National Monument. By educating students and increasing the level of awareness in the public by stressing the unique qualities of the local archeological resources, we hope to engender a sense of public "ownership" and pride that will have a positive effect on the preservation of the Monument's archaeological resources.

The excavation mockup, radiocarbon and tree-ring dates cited, and artifacts displayed - indeed, the Arroyo site itself - are the result of recognizing and seizing on opportunities for productive research that turn up during the course of every-day BLM cultural resource management activities. Since the local BLM program started in 1976, archaeological sites damaged or exposed by erosional cuts, looting episodes, inadvertent construction disturbance, and road grading and have yielded a wealth of data, while allowing more pristine resources to be preserved. These opportunistic chances to recover data have contributed greatly to our understanding of local prehistory.

Artifact collections, accrued over the past thirty years, are curated in the repository at Southern Utah University. They are a major source of data, inspiration, and future research potential. Archaeological survey, much of it conducted inhouse, has resulted in the documentation of hundreds of sites with sizable ceramic and artifact samples. Many of these collections were recovered at a time when rampant looting led us to believe there would be little left in the future. The collections are washed, have accession numbers assigned, and are systematically stored and ready to be analyzed – usually for the first time, but in many cases, after decades in the drawers, are due for a second look. In conjunction with the new lab facility, development of the education program, and collections available from SUU, the Monument mission to promote science and education should have plenty of data to work with.

It is also hoped that one of the outcomes of publishing this report will be an appreciation by the public for the complex interrelationships between the many disciplines which have contributed to the description and interpretation of the Arroyo site. While it is intended to be scientifically comprehensive,

with the development of appropriate curricula, the volume may be used to provide background and guide for research by students of all ages. Hopefully, the Arroyo site report will play an important role in the Monument's education mission. First and foremost, however, this volume is the primary documentation of the excavation. Those portions of the site that were excavated are irretrievably gone – the artifacts, samples, and report are all that remain for future scholars to use. This book is now the resource – we hope we have done the Arroyo site justice.

References

Aikens, C. Melvin

1965 *Excavations in Southwestern Utah.* University of Utah Anthropological Papers No.76. Salt Lake City.

1967 *Virgin-Kayenta Cultural Relationships.* University of Utah Anthropological Papers No. 79. Salt Lake City.

Agenbroad, Larry D., and Jim Mead

1989 Quaternary geochronology and distribution of *mammuthus* on the Colorado Plateau. *Geology* 17(9):861-864.

Ahlstrom, Richard V. N. (editor)

2000 Pithouse Excavations at the Parkwash Site (42Ka4280) Grand Staircase-Escalante National Monument Southcentral Utah. HRA Papers in Archaeology No. 1. HRA, Inc. Las Vegas.

Allison, James R.

1990 *Anasazi Subsistence in the St. George Basin, Southwestern Utah.* Unpublished Master's Thesis, Department of Anthropology, Brigham Young University, Provo, Utah.

1998 Ceramic Analysis. In *Excavation/Mitigation Report, Three Sites Near Hildale, Utah: 42Ws2195, 42Ws2196, AZB:1:35 (BLM) (Reservoir Site)*, compiled by Asa S. Nielson, pp. 9-1-9-21, Research Report No. 98-8. Baseline Data, Orem, Utah.

2008 Shinarump Red Ware and Other Red Ware pottery North and West of the Colorado River. *Pottery Southwest.* Vol.27-1.

Altschul, Jeffrey H.and H.C. Fairley

1989 *Man, Models and Management: An Overview of the Archaeology of the Arizona Strip and the Management of its Cultural Resources.* Report prepared for USDA Forest Service, USDI Bureau of Land Management, Denver.

Ambler, J. Richard

1985 Northern Kayenta Ceramic Chronology. In *Archaeological Investigations near Rainbow City Navajo Mountain, Utah*, Phil R. Geib, J. Richard Ambler and Martha M. Callahan, editors, pp.24-66, Northern Arizona University Archaeological Report No. 576, Flagstaff.

Ashcroft, Gaylen L., Donald T. Jensen, and Jeffrey L. Brown

1992 *Utah Climate.* Utah Climate Center, Utah State University, Logan, Utah.

Beaglehole, Pearl

1937 Foods and Their Preparation. In *Notes on Hopi Economic Life*, by Ernest Beaglehole, pp. 60 71. Yale University Publications in Anthropology 15.

Beals, Ralph L., George W. Brainerd, and Watson Smith

1945 *Archaeological Studies in Northeast Arizona: A Report on the Archaeological Work of the Rainbow Bridge-Monument Valley Expedition.* University of California Publications in American Archaeology and Ethnology, Vol. 44, No.1. University of California Press.

Benson, Larry V. and Michael S. Berry

2009 Climate Change and Cultural Response in the prehistoric American Southwest. *Kiva* 75(1): 87-117.

Bernardini, Wesley

2005 Reconsidering Spatial and Temporal Aspects of Prehistoric Cultural Identity: A Case Study from the American Southwest. *American Antiquity* 70:1:31-55.

Berry, Claudia F. and Michael S. Berry

1986 Chronological and Conceptual Models of the Southwestern Archaic. In *Anthropology of the Desert West*, edited by C.J. Condie and D.D. Fowler, pp 243-327. University of Utah Anthropological Paper No.110. Salt Lake City.

Berry, Michael S.
2000 Chronometry and Process: Southwestern Agricultural Beginnings. Paper presented at the 65th Annual Meeting of the Society for American Archaeology.

Binford, Lewis R.
1978 *Nunamiut Ethnoarchaeology*. Academic Press, Inc., New York.

1981 *Bones: Ancient Men and Modern Myths*. Academic Press Inc., Orlando.

Braun, D.P.
1983 Pots as Tools. In *Archaeological Hammers and Theories*, edited by J.A. Moore and A.S. Keene, pp.107-134. Academic Press, New York.

Breternitz, David A., Arthur H. Rohn, Jr., and Elizabeth A. Morris
1974 *Prehistoric Ceramics of the Mesa Verde Region* (2nd ed.). Interpark, Cortez, Colorado.

Brown, Gary M.
1982 Archaeological Investigations at Yankee Target: A Prehistoric Chert Quarry on the Arizona Strip, Northwest Mohave County. Submitted to USDI, Bureau of Land Management, Arizona Strip District by Abajo Archaeology, Bluff, Utah.

Bye, Robert A., Jr.
1972 Ethnobotany of the Southern Paiute Indians in the 1870's: With a Note on the Early Ethnobotanical Contributions of Dr. Edward Palmer. In *Great Basin Cultural Ecology, a Symposium*, edited by D. D. Fowler, pp. 87-104. Publications in the Social Sciences No. 8. Desert Research Institute, Reno, Nevada.

Carter, James A., Daron Duke, and D. Craig Young
2004 *Limited Site Testing at 22 Archaeological Sites in the Wild Isle Project Area, Utah Test and Training Range, Tooele County, Utah.* Produced by EM Assist in Ogden, Utah, and Historical Research Associates in Seattle Washington. Prepared for Hill Air Force Base, Ogden, Utah.

Castetter, Edward F.
1935 Uncultivated Native Plants Used as Sources of Food. *Ethnobiological Studies in the American Southwest.* The University of New Mexico Bulletin, No. 266, Biological Series Vol. 4, No.1, University of New Mexico Press, Albuquerque.

Castetter, Edward F. and Willis H. Bell
1942 *Pima and Papago Indian Agriculture.* University of New Mexico Press, Albuquerque.

Chamberlin, Ralph V.
1964 *The Ethnobotany of the Gosiute Indians of Utah.* American Anthro¬pological Association Memoirs 2:329 405. Kraus Reprint Corp. New York. (Originally printed 1911).

Chapin-Pyritz, Regina L.
2000 Chapter 7, Faunal Remains. In *Pithouse Excavations at the Park Wash Site (42Ka4280), Grand Staircase-Escalante National Monument, Southcentral Utah.* HRA Papers in Archaeology No. 1, ed. by Richard V.N. Ahlstrom.

Christenson, Andrew L.
1994 A Test of Mean Ceramic Dating Using Well-dated Kayenta Anasazi Sites. *Kiva* 59(3):297-317.

Christensen, Diana, Susan M. Chandler, Kim Kreutzer, and Jeff Jennings
1983 *Results of the 1982 Class II Archaeological Survey of the Alton and Kolob Tracts in Northwestern Kane County, Utah.* Prepared for the BLM Kanab Resource Area by Nickens and Associates. Montrose, Colorado.

Classen, P. W.
1919 A Possible New Source of Food Supply (Cat tail Flour), *Scientific Monthly* 9:179 185.

Clark, Jeffery J. Clark
2001 *Tracking Prehistoric Migrations Pueblo Settlers among the Tonto Basin Hohokam.* Anthropological Papers of the University of Arizona, No.65. University of Arizona Press, Tucson.

Collette, Jim H., Kimberly Spurr
2002 *An Archaeological Sample Survey of the Big Water Trust Land Block, East Clark Bench, Utah.* Prepared for Utah School and Institutional Trush Lands Administration by Navajo Nation Archaeology Department. Report No. 00-56. Flagstaff, Arizona.

Colton, Harold S.
1952 *Pottery Types of the Arizona Strip and Adjacent Areas in Utah and Nevada.* Museum of Northern Arizona Ceramic Series 1, Northern Arizona Society of Science and Art, Flagstaff.
1974 Hopi History and Ethnobotany. In *Hopi Indians.* pp. 279-424. Garland Publishing Inc., New York.

Colton, Harold Sellers and Lyndon Lane Hargraves
1937 *Handbook of Northern Arizona Pottery Wares.* Museum of Northern Arizona Bulletin No. 11, Flagstaff.

Copeland, James M. and Richard E. Fike
1988 Fluted Projectile Points in Utah. *Utah Archaeology* 1988 1 (1):5-28.

Cummings, Linda Scott
1995 *Pollen Analysis at Site 42Ka3976, Southwest Utah.* Paleo Research Labs Technical Report 94-03C. Prepared for the USDI, Bureau of Land Management, Kanab Resource Area, Kanab Utah.

Cushing, Frank Hamilton
1920 Zuni Breadstuff. *Indian Notes and Monographs.* Vol. VIII. Museum of the American Indian, Heye Foundation, New York.

Dalley, Gardiner F.
1970 In Awls; *Median Village and Fremont Culture Regional Variation* by John P. Marwitt. University of Utah Anthropological Papers No.95. Salt Lake City.

Dalley, Gardiner F. And Douglas A. McFadden
1985 *The Archaeology of the Red Cliffs Site.* Utah Bureau of Land Management Cultural Resource Series No. 17. Salt Lake City.
1988 *The Little Man Archaeological Sites: Excavations on the Virgin River near Hurricane, Utah.* Utah Bureau of Land Management Cultural Resource Series No. 23. Salt Lake City.

Delorit, Richard J.
1970 *An Illustrated Taxonomy Manual of Weed Seeds.* Agronomy Publications, River Falls, Wisconsin.

DiPeso, Charles, John B. Rinaldo, and Gloria J. Fenner
1974 Casas Grandes Ceramic Artifacts. In *Casas Grandes: A Fallen Trade Center of the Gran Chichimeca*, Vol. 6, Ceramics and Shell, pp. 330-82. Dragoon Foundation, Northland Press, Flagstaff.

Dobyns, F.
1979 Altitude Sorting of Ethnic Groups in the Southwest. *Plateau* 47:42-48.

Doelling, Hellmut, Robert E Blackett, Alden H. Hamblin, J. Douglas Powell and Gayle L. Pollock
2000 Geology of grand Staircase-Escalante National Monument, Utah. In *Geology of Utah's parks and Monuments.* Utah Geological Association Publication 28. D.A. Sprikel , T.C. Chidsey, Jr., and P.B. Anderson, editors.

Doelling, Hellmut, Gitzhugh D. Davis and Cynthia J. Brandt
1989 *The Geology of Kane County, Utah: Geology, Mineral Resources, Geologic Hazards.* Utah Geological and Mineral Survey Bulletin 124, Utah Department of Natural Resources, Salt Lake City.

Dohr, Susan Lintz
1994 Demographic, Climatic and Settlement Pattern Change Among the Western Anasazi of Kane County, Utah. Unpublished Master's Thesis, Department of Anthropology, California State University, Long Beach.

Dohr, Susan Lintz, Selma Morley
1993 Demographic, Climatic and Settlement Pattern Change Among the Western Anasazi Between AD 500-1250: A New Assessment of Survey Data. Paper presented at the Annual Meeting of the Society for American Archaeology. St. Louis, Missouri.

Eccles, Cindy and Barbara Walling-Frank
1998 Chipped and Ground Stone Tool Analysis. In *Excavation/Mitigation Report Three Sites Near Hildale, Utah 42Ws2195, 42Ws2196, AZ B:1:35 (BLM) (Reservoir Site)*. Compiled by Asa S. Nielson. Submitted to USDI, Bureau of Land Management, Cedar City District.

Emslie, Steven
1978 Dog Burials from Mancos Canyon, Colorado. *Kiva* 43(3-4):167-182.

1977 Interpretation of Faunal Remains from Archaeological Sties in Mancos Canyon, Southwestern Colorado. Unpublished MA thesis, Department of Anthropology, University of Colorado.

1980 Big Westwater Bird Remains. In, *Big Westwater Ruin by La Mar Lindsey. Excavation of Two Anasazi Sites in Southern Utah 1979-1980.* Utah BLM Cultural Resource Series No. 9. Salt Lake City.

Euler, Robert C.
1994 Aspects of the Virgin Anasazi Tradition in Grand Canyon. *Utah Archaeology* 1994 7 (1) 99-103.

Fairley, H. C.
1989 Culture History. In *Man, Models, and Management: An overview of the Arizona Strip and the Management of its Cultural Resources*, edited by J. H. Altschol and H. C. Fairley, pp 53 -243. Report prepared for USDA, FS: USDI, BLM.

Fewkes, J. W.
1896 Contributions to Ethnobotany. *American Anthropologist* 9:14-21.

Fiero, Kathleen
2000 Preservation Maintenance in Grand Staircase-Escalante National Monument Kane County, Utah. Ms. On file, Grand Staircase-Escalante National Monument Headquarters, Kanab Utah.

Firor, James
1994 Excavation of Two Prehistoric Southern Paiute Sites Near Kanab, Utah. Prepared for ERA Utah Properties, Inc. by Alpine Archaeological Consultants, Inc. Montrose, Colorado.

Flinders, Jerran T., Duke S. Rogers, Jackee L. Webber-Alston, and Harry A. Barber
2002 *Mammals of the Grand Staircase-Escalante National Monument. A Literature and Museum Survey.* Reprinted from the Monographs of the Western North American Naturalist (2002) 1:1-64.

Ford, Richard I.
1968 An Ecological Analysis Involving the Population of San Juan Pueblo, New Mexico. Ph.D. dissertation, Department of Anthropology, University of Michigan, Ann Arbor.

1984 Ecological Consequences of Early Agriculture in the Southwest. In *Papers on the Archaeology of Black Mesa, Arizona,* vol. 2, edited by S. Plog and S. Powell, pp. 127-138. Southern Illinois University Press, Carbondale.

Frank, Barbara W.
1997 Analysis and Documentation of Chipped Lithic and Ground Stone Artifacts in the Zion National Park Collections. Ms. on file, Zion National Park, Springdale, Utah.

Frank, Barbara W. and Richard A. Thompson
1995 The Interim Report: 1994 Southern Utah University field School Excavations at the Corngrower Site AZ B:1:102 (BLM), Colorado City. Ms on file at Bureau of Land Management Arizona Strip District Office, St. George Utah.

French, David H.
1971 Ethnobotany of the Umbelliferae. In *The Biology and Chemistry of the Umbelliferae*, edited by V.H. Heywood. pp. 385-412. Academic Press, New York.

Gallagher, Marsha V.
1977 *Contemporary Ethnobotany Among the Apache of the Clarkdale, Arizona Area Coconino and Prescott National Forests.* USDA Forest Service Archeological Report 14. USDA Forest Service, Southwest Region, Albuquerque.

Gasser, Robert E.
1982a Hohokam Use of Desert Food Plants. *Desert Plants* 2(4):216 234.

1982b *The Coronado Project Archaeological Investigations: The Specialist Volume: Biocultural Analysis.* Museum of Northern Arizona Research Paper No. 23, Coronado Series 4. Museum of Northern Arizona, Flagstaff.

Geib, Phil R. and Dale Davidson
1994 Anasazi Origins: A Perspective From Preliminary Work At Old Man Cave. *Kiva.* 60:191-202.

Geib, Phil R., Jim H. Collette and Kimberly Spurr
2001 *KAIBABITSINUNGWU An Archaeological Sample Survey of the Kaiparowits Plateau.* Utah Cultural Resource Series No.25,Grand Staircase - Escalante National Monument Special Publication No.1. Utah Cultural Resource Series No. 25, USDI, Bureau of Land Management, Salt Lake City.

Glassow, Michael A.
1980 *Prehistoric Agricultural Development in the Northern Southwest, A Study in Changing Patterns of Land Use.* Ballena Press. Socorro, New Mexico.

Graf, Julia B., Webb, Robert H. and Richard Hereford
1991 *Relation of Sediment Load and Flood-Plain formation to Climatic Variability, Paria River Drainage Basin, Utah and Arizona.* Geological Society of America Bullitin, 103 (11) 1405-1415.

Grayson, Donald K.
1984 *Quantitative Zooarchaeology.* Academic Press, New York.

Greenhouse, Ruth, Robert E. Gasser and Jannifer W. Gish
1981 Cholla Bud Roasting Pits: An Ethnoarchaeological Example. *Kiva* 46(4):227 242.

Gumerman, George J. (editor)
1988 *The Anasazi in a Changing Environment.* Cambridge University Press, Cambridge.

Gumerman, George, IV, and Bruce S. Umento
1987 The Siphon Technique: An Addition to the Flotation Process. *American Antiquity* 52(2):330-336.

Hack, J.T.
1942 *The Changing Physical Environment of the Hopi Indians of Arizona.* Reports of the Awatovi Expedition, No. 1.

Hard, Robert J., and William L. Merrill
1992 Mobile Agriculturalists and the Emergence of Sedentism: Perspectives from Northern Mexico. *American Anthropologist* 94:601-620.

Harrington, H. D.
1967 *Edible Native Plants of the Rocky Mountains.* University of New Mexico Press, Albuquerque.

Hauck, F.R.
1979 *Cultural Resource Evaluation in South central Utah 1977.* Cultural Resource Series No. 4. Bureau of Land Management, Utah State Office, Salt Lake City.

Heath, Kathleen M.
1986 Seeds of Change? Macrofossil Analysis and Interpretation from Quail Creek. In *Excavations at Quail Creek*, by Barbara Walling, Richard A. Thompson, Gardiner F. Dalley, and Dennis G. Weber, pp. 477-498. Cultural Resource Series No. 20. Bureau of Land Management, U. S. Department of the Interior, Salt Lake City.

1988a Microfossils and Micro-Refuse Analysis from the Little Man Sites. In *The Little Man Archaeological Sites: Excavations on the Virgin River near Hurricane, Utah*, by Gardiner F. Dalley and Douglas A. McFadden, pp. 303-319. Cultural Resource Series 23, Bureau of Land Management, U. S. Department of the Interior, Salt Lake City.

1988b The Red Cliffs Flotation Analysis. In *The Little Man Archaeological Sites Excavations on the Virgin River near Hurricane, Utah*, by Gardiner F. Dalley and Douglas A. McFadden, pp. 320-328. Cultural Resource Series No. 23. Utah Sate Office, Bureau of Land Management, U. S. Department of the Interior, Salt Lake City.

Hereford, Richard

1986 Modern Alluvial History of the Paria river drainage Basin, Southern Utah. *Quaternary Research* 25:293-311.

2002 Valley-Fill Alluviation (ca. A.D. 1400-1880) during the Little Ice Age, Paria River Basin and Southern Colorado Plateau, USA. *Geological Society of America Bulletin* 114(12):1550-1563.

Hereford, Richard and Robert H. Webb

2000 Proposal for an Interagancy Agreement Between the Bureau of Land Management and U.S. Geological Survey to investigate The late Quaternary surfical Geology and Geomorphology of the Kitchen Corral Wash Archeologic Area Grand Staircase-Escalante National Monument, Utah. On file at the BLM, GSENM headquaters, Kanab.

Herr, Sarah

1993 Broken Pots as Tools. In *Across the Colorado Plateau: Anthropological Studies for the Transwestern Pipeline Expansion Project*, Vol. XVI, Interpretation of Ceramic Artifacts, by B.J. Mills, C. E. Goetze, and M.N. Zedeno, pp. 347-76.

Heide, James

1982 Settlement Patterns on Little Creek Mountain, Utah. *Western Anasazi Reports.* 3 (2): 87-179.

Holmer, Richard N.

1978 A Mathematical Typology for Archaic Projectile Points of the Eastern Great Basin. Ph.D. Dissertation, University of Utah.

1986 Common Projectile Points of the Intermountain West. In *Anthropology of the Desert West : Essays in Honor of Jesse D. Jennings*, Edited by Carol J. Condie and Don D. Fowler , pp.89-115. University of Utah Anthropological Paper 110. Salt Lake City.

Holmer, Richard N. and Dennis G. Weder

1980 Common Post-Archaic Projectile Points of the Fremont Area. In *Fremont Perspectives,* edited by David B. Madsen, pp. 55-68. Antiquities Section Selected Papers No. 16. Utah State Historical Society, Salt Lake City.

Hough, Walter

1898 Environmental Interpretations in Arizona. *American Anthropologist* 11:133-155.

Huffman J., Phagan C. J., Haynes G., and Burchett T.

1990 *Archaeological survey on the Kanab Plateau: 1989-90 Annual technical Report. Northern Arizona University Archaeology Report No. 1044.* Prepared for the Division of Resources Management and Planning, Grand Canyon National Park, by Department of Anthropology, Northern Arizona University, Flagstaff.

Janetski, Joel C., Mark L. Bodily, Bradley A. Newbold, and David T. Yoder

2012 The Paleoarchaic to early Archaic Transition on the Colorado Plateau: The Archaeology of North Creek Shelter. *American Antiquity* 77 :125-159.

Janetski, Joel C. and James D. Wilde

1989 A Preliminary Report of Archaeological Excavations at Antelope Cave and Rock Canyon Shelters, Northwestern Arizona. *Utah Archaeology* 1989 1:88-106.

Jennings, Jesse D.

1959 *The Glen Canyon Archaeological Survey, Part II.* Glen Canyon Series No. 6. University of Utah Anthropological Paper 39. SLC.

Judd, Neil M.

1926 *Archeological Observations North of the Rio Colorado.* Bureau of American Ethnology. Bulletin 82. Washington.

Kearney, T. H., and R. H. Peebles

1960 *Arizona Flora.* University of California Press, Berkeley.

Kearns, Timothy M.
1982 The Escalante Project: A Class II Cultural Resource Inventory of Preference Right Coal Lease Tracts in South Central Utah. Copy on file Grand Staircase – Escalante National Monument, Kanab, Utah.

Keepax, C.
1977 Contamination of Archaeological Deposits by Seeds of Modern Origin with Particular Reference to the Use of Flotation Machines. *Journal of Archaeological Science* 4:221-229.

Keller, Don D.
1987 Archaeological Investigations, Utah International, Inc., Alton Coal Project, Kane County, Utah. Report A 86-50. Ms on file at the BLM, Grand Staircase - Escalante National Monument Headquarters, Kanab.

2000 Archaeological Survey of the Escalante River Canyon, Highway 12 to the Glen Canyon NRA Boundary, Garfield County, Utah. Ms on file at BLM, Grand Staircase-Escalante National Monument Hq. Kanab.

Kelly, Isabel T.
1964 *Southern Paiute Ethnography.* University of Utah Anthropological Papers No. 69, University of Utah, Salt Lake City.

Kirk, Donald R.
1975 *Wild Edible Plants of Western North America.* Naturegraph Publishers, Happy Camp, CA.

Klein, Richard G., and Kathryn Cruz-Uribe
1984 The Analysis of Animal Bones from Archaeological Sites. University of Chicago Press, Chicago.

Kulp, Thomas R.
1995 *Quaternary Paleoclimate Variation as Evidenced by Paleosols: Implications for Anthropogenic Impact on Landscape Instability Around an Anasazi Site in Kane County, Utah.* Unpublished Master's Thesis, Department of Geology, East Carolina University. On file GSENM Headquarters, Kanab.

Lister, F.C.
1959 Pottery. In *The Coombs Site*, R.H. Lister et al. University of Utah Anthropological Papers No. 41, Part 1. Salt Lake City.

1960 Pottery In *The Coombs Site*, R.H. Lister et al. University of Utah Anthropological Papers No. 41, Part 2. Salt Lake City.

1961 Pottery In *The Coombs Site*, R.H. Lister et al. University of Utah Anthropological Papers No. 41, Part 3. Salt Lake City.

Lister, Robert H.
1959 *The Coombs Site, Part One.* University of Utah Anthropological Papers No 41. Glen Canyon Series No.8. Salt Lake City.

Lopinot, N. H., and D. E. Brussell
1982 Assessing Uncarbonized Seeds from Open-Air Sites in Mesic Environments: An Example from Southern Illinois. *Journal of Archaeological Science* 9:95-108.

Lupo, Karen D., and Joel C. Jaentski
1994 Evidence of Domesticated Dogs and Some Related Canids in the Eastern Great Basin. *Journal of California and Great Basin Anthropology.* 16(2):199-220.

Lyman, R. Lee
1992 Anatomical Considerations of Utility Curves in Zooarchaeology. *Journal of Archaeological Science.* 19:7-22

Lyneis, Margaret M.
1988 Ceramic production and exchange among the Virgin Anasazi. Paper presented at the 53rd Annual Meeting of the Society for American Archaeology, Phoenix.

1992 *The Main Ridge Community at Lost City: Virgin Anasazi Architecture, Ceramics and Burials.* University of Utah Anthropological Papers No.117, Salt Lake City.

1992 Social Complexity Among the Lowland Virgin Anasazi. *Kiva* 57(3):197-212.

1995 The Virgin Anasazi, Far Western Pueblos. *Journal of World Prehistory* 9(2):199-241.

1998 The Shinarump Problem 2 Plain Ware and Red Ware Adrift on a Sea of Sand. Prepared for the Virgin Region Ceramics Working Group, in possession of author at Department of Anthropology, University of Nevada, Las Vegas.

Madsen, David B. and Steven R. Simms
1998 The Fremont Complex: A Behavioral Perpspective. *Journal of World Prehistory*. 12(3) 255-336.

Martin, A. C., and W. D. Barkley
1961 *Seed Identification Manual.* University of California Press, Berkeley.

Martin, Steve L.
1992a Macrobotanical Analysis of a Soil Sample from Room 1 of Site 42Ka1568. Ms. of file, Department of Anthropology, California State University, Long Beach.

1993 The Chemical Analysis of Archaeologically Associated Sediments: A Case from the American Southwest. Unpublished Master's Thesis. Univeristy of California, Los Angeles.

1995 Macrobotanical Analysis of Soil Samples from the Arroyo Site (42Ka3976). Ms. submitted to the USDI, Bureau of Land Management, Kanab Resource Area, Kanab, Utah.

1996a Macrobotanical Analysis of Soil Samples from the Mixmaster (42Ws920) and Canine (42Ws881) Sites. Ms. on file, Southern Utah State College Museum, Cedar City.

1996b A Dietary Reconstruction for the Virgin River Branch Anasazi: Subsistence in a Marginal Environment. Unpublished Ph.D. dissertation, Archaeology Program, University of California, Los Angeles, California.

1997 A Dietary Reconstruction for the Virgin River Branch Anasazi. Learning From the Land, Grand Staircase - Escalante National Monument Science Symposium Proceedings. USDI, Bureau of land Management, SLC.

1999 Virgin Anasazi Diet as Demonstrated through the Analysis of Stable Carbon and Nitrogen Isotopes. *Kiva* 64(4):495-514.

McFadden, Douglas A.
1993 Virgin Anasazi Settlement on the Grand Staircase. Presented at the 10th annual Utah Professional Archaeological Council. Southern Utah University.

1996 Virgin Anasazi Settlement and Adaptation on the Grand Staircase. *Utah Archaeology 1996* 9(1):1-34.

2000a Formative Chronology and Site Distribution on the Grand Staircase - Escalante National Monument. Draft Ms on file at the Grand Staircase - Escalante National Monument Headquarters. Kanab, Utah.

2000b The Arroyo Site, 42Ka3976: Archaic Level Investigations. *Utah Archaeology 2000* 13 (1) 15-24.

2000c The Skutumpah Mammoth Excavation. *CRM 23* (3):18, USDI, National Park Service, Cultural Resources.

2002 Who's Who on the Monument? Virgin, Kayenta and Fremont Relationships. Paper presented at the 2002 Annual Meeting of the Society for American Archaeology, Denver.

2003 The Middle Trail Inventory: Evidence for Pueblo IV Presence North of the Colorado River. Ms on file at Grand Staircase - Escalante National Monument Headquarters. Kanab, Utah.

2004 House Rock Valley Inventory: Pleasant Valley Outlet Tract, An Alluvial Fan Floodwater Outwash System on the Arizona Strip. Ms. on file at Grand Staircase - Escalante National Monument Headquarters. Kanab, Utah.

2010 Archaeological Investigations on The Paria Plateau, Vermilion Cliffs National Monument 2008 and 2009: The Pinnacle Ridge and White Knolls Surveys. MS on file at the Vermilion Cliffs National Monument, St. George.

McKern T.W., Stewart T.D.
1957 Skeletal Age Changes in Young American Males: Analyzed from the Standpoint of Age Identification. Technical report EP-45. U.S. Army, Natick, Mass.

McKusik, Charmion
1985 The Avian Remains. In Archeological Investigations at Antelope House, by D. P. Morris, pp. 159-164. National Park Service. Washington DC.

Metcalfe, Duncan
1981 The Cockscomb Project. Prepared for Utah Power and Light Company by University of Utah Archeological Center. Reports of Investigations 80-2.

Meyer, F. C.
1980 Carbonized Food Plants of Pompeii, Herculaneum, and the Villa at Torre Annunziata. *Economic Botany* 34(4):401-437.

Minnis, P. E.
1978 *Paleoethnobotanical Indicators of Prehistoric Environmental Disturbance: A Case Study.* In The Nature and State of Ethnobotany, edited by R. Ford, pp. 347-366. Anthropological Papers No. 75. University of Michigan, Museum of Anthropology, Ann Arbor.

1981 Seeds in Archaeological Sites: Sources and Some Interpretive Problems. *American Antiquity* 46:143-152.

1989 Prehistoric Diet in the Northern Southwest: Macroplant Remains from Four Corners Feces. *American Antiquity* 54(3):543-563.

Morley, Selma E.
1993 A Study of the Development of the Final Occupation of 42Ka1568: A Late Anasazi Pueblo in South Central Utah. Unpublished Master's thesis, Department of Anthropology, California State University, Long Beach.

Mueller, James W.
1974 The Use of Sampling in Archaeological Survey. Memoirs of the Society for American Archaeology. No.28, *American Antiquity* Vol. 39 No.2 Part 2.

Munroe, Natalie
1994 An Investigation of Anasazi Turkey Production in Southwestern Colorado. Unpublished masters thesis, Department of Archaeology, Simon Fraser University, Burnaby, Canada.

Neff, Linda Stephen
1996 Ancient Pueblo Spinning Traditions in the Northern Southwest. Unpublished masters thesis, Deparment of Anthropology, Northern Arizona University. Flagstaff.

Neff, Hector, Daniel O. Larson and Michael D. Glascock
1997 The Evolution of Anasazi Ceramic Production and Distribution: Compositional Evidence from a Pueblo III Site in South-Central Utah. *Journal of Field Archaeology* 24(4):473-492.

Nauta, Lis
1995 Unmodified Faunal Remains From 42Ka3976. Ms on file at the BLM, Grand Staircase-Escalante National Monument Headquarters. Kanab, Utah.

Nequatewa, Edmund
1943 Some Hopi Recipes for the Preparation of Wild Plant Foods. *Plateau* 16(1):18 20.

Newberry, J. S.
1888 Food and Fiber Plants of the North American Indians. *Popular Science Monthly* 32:31-46.

Nickens, Paul R. and K.L. Kvamme
1981 Archaeological investigations at the Kanab Site, Kane County, Utah. In, *Excavations of Two Anasazi Sites in Southern Utah 1979-1980*, assembled by R.E. Fike and D.B. Madsen. Cultural Resource Series No.9. USDI Bureau of Land Management, Utah State Office, Salt Lake City.

Newman, Deborah E.
1990 Results of Pollen and Macrobotanical Analysis from the Hilldale Sites (42Ws2195 and AZ B:1:35). Report Submitted to Nielson Consulting Group, Orem, Utah.

Nielson, Asa S. (Compiler)
1998 Excavations/Mitigation Report Three Sites Near Hildale, Utah 42Ws2195, 42Ws2196, AZ B:1:35 (BLM) (Reservoir Site). Submitted by Baseline Data to the Utah and Arizona Bureau of Land Management State Offices.

Nusbaum, Jesse L.
1922 *A Baskmaker Cave in Kane County, Utah.* Indian Notes and Monographs, Miscellaneous Series No.29, Heye Foundation, New York City.

Olsen, Stanley J.
1968 *The Osteology of the Wild Turkey. Appendix in Fish, Amphibian and Reptile Remains from Archaeological Sites*, by Stanley J. Olsen, pp. 107-137. Papers of the Peabody Museum of Archaeology and Ethnology 56(2):107-137.

Oppelt, Norman T.
1984 Worked Potsherds of the Prehistoric Southwest: Their Forms and Distributions. *Pottery Southwest* January: 1-6.

Ortner DJ and Putschar WGJ
1985 *Identification of Pathological Conditions in Human Skeletal Remains.* Smithsonian Institution Press, Washington, D.C.

Palmer, Edward
1871 Food Products of the North American Indians. In Report of the Commissioner of Agriculture for 1870, edited by J. R. Dodge, pp. 404 428. U.S. Government Printing Office, Washington D.C.

Peckham, Stewart
1990 *From This Earth: The Ancient Art of Pueblo Pottery.* Museum of New Mexico Press.

Perry, Laureen M.
2000 Ceramics. *In Pithouse Excavations at the Park Wash Site (42Ka4280)Grand Staircase - Escalante National Monument Southcentral Utah*, edited by Richard V.N. Ahlstrom, pp 41-55. HRA Papers in Archaeology No.1. HRA Inc. Las Vegas.

Polyak, Victor J., Jessica B.T. Rasmussen and Yemane Asmerom
2004 Prolonged wet period in the southwestern United States though the Younger Dryas. *Geology* 32: 5-8.

Reed Eric K.
1949 The Significance of Skull Deformation in the Southwest. *El Palacio* 56:4-10.

Rice, P.M.
1987 *Pottery Analysis: A Sourcebook.* University of Chicago Press, Chicago.

Robbins, W.W., J. P. Harrington and Barbara Freire Marreco
1916 *Ethnobotany of the Tewa Indians.* Bureau of American Ethnology Bulletin 55.

Roberts, Heidi
1997 A Comparison of Human Skeletal Remains From Virgin Anasazi, Katenta Anasazi, and Parowan Fremont archaeological Sites. *Utah Archaeology* 1997 10 (1): 31-44.

Scheuer J.L., Musgrave J.H., and Evans S.P.
1980 The Estimation of Late Fetal and Perinatal Limb Bone Length by Linear and Logarithmic Regression. Annals of Human Biology 7:257-265.

Schleisman, Dean, and Asa S. Nielson
1988 *Archaeological Excavations at Hog Canyon Dune (Site 42Ka2574), Hog Creek Canyon, Kane County, Utah.* Museum of Peoples and Cultures Technical Series No. 87-26. Brigham Young University, Provo, Utah.

Schopmeyer, C. S.
1974 Seeds of Woody Plants in the United States. Agricultural Handbook No. 450. U. S. Department of Agriculture, Forest Service, Washington, D.C.

Schroeder, A.H.
1955 *Archaeology of Zion Park.* University of Utah Anthropological Papers No. 22. Salt Lake City.

Schroedl, Alan
1991 Paleo-Indian Occupation in the Eastern Great Basin and Northern Colorado Plateau. *Utah Archaeology* 1991 4 (1) :1-15.

Sciulli, P.W.
1992 Estimating Age of Occurrence of Enamel Defects in Deciduous Teeth. In Recent Contributions to the Study of Enamel Developmental Defects, AH Goodman and LL Capasso, eds. *Journal of Paleopathology* Monographic Publication #2, Teramo, Italy.

Shepard, A.O.
1956 *Ceramics for the Archaeologist.* Carnegie Institution of Washington, Publication 609. Washington D.C.

Shutler, Richard, Jr.
1961 *Lost City: Pueblo Grande de Nevada.* Nevada State Museum Anthropological Papers No. 5. Carson City.

Smith, Elmer R.
1934 A Brief Description of an Indian Ruin Near Shonesburg, Utah. Zion –Bryce Nature Notes 6 (1), Zion National Park.

Steele, D.G. and Bramblett, C.A.
1988 *The Anatomy and Biology of the Human Skeleton.* Texas A&M University Press, College Station, Texas.

Stevenson, M. C.
1915 Ethnobotany of the Zuni Indians, 30th Annual Report of the Bureau of American Ethnology, Washington, D.C.

Steward, Julian H.
1941 *Archaeological Reconnaissance of Southern Utah.* Bureau of American Ethnology Bulletin, Vol. 128. Washington D.C.

Stokes, William Lee
1986 *Geology of Utah.* Occasional Paper Number 6 of the Utah Museum of Natural History. Utah Museum of Natural History, University of Utah and Utah Geological and Mineral Survey Department of Natural Resources. Salt Lake City.

Talbot, Richard K., Lane D. Richens, Shane A. Baker, Joel C. Janetski
1999 Broken Arrow Cave (42Ka4356): 1997 Testing Results. Brigham Young University Museum of Peoples and Cultures Technical Series No. 99-5. Prepared for BLM Kanab Resource Area by Office of Public Archaeology Brigham young University, Provo, Utah.

Thompson, Charmaine
1990 Anasazi Social Boundaries and Resource Access: The Faunal Evidence from Nancy Paterson Village, Utah. Unpublished masters thesis, Department of Anthropology, Brigham Young University, Provo.

Thompson, Richard A.
1971 The Grand Canyon National Monument 1970 Archaeological Survey Preliminary Report. Ms. On file at Southern Utah University Archaeological Laboratory and Repository.

1986 Ceramic Analysis. In: *Excavations at Quail Creek*, B. Walling et al. Utah-Bureau of Land Management Cultural Resource Series No. 20. Salt Lake City.

1986 Ceramics. In *Excavations at Quail Creek,* Gardiner F. Dalley, volume editor, pp. 351-379, Bureau of Land Management Utah Cultural Resource Series No. 20, Salt Lake City.

Thompson, Richard A. and Georgia Beth Thompson
1982 The Prehistory and Environment of Southwest Utah. Ms. On file at Southern utah University Archaeological laboratory and Repository .Cedar City.

Tipps, Betsy L.
1989 Cultural Resource Investigations Near Kanab, Utah: Excavation and Structural Stabilization at Cottonwood Canyon Cliff Dwelling. P-III Associates. On file at the USDI, BLM, GSENM Hq., Kanab, Utah.

Compare digital PDF item for TIA

1995 *Holocene Archeology Near Squaw Butte, Canyonlands National Park.* Selections from the Division of Cultural Resources, No.7. Rocky Mountain Region, NPS, Denver.

Turner, G. Christy II and Jacqueline A. Turner
1999 *Man Corn: Cannibal and violence in the Prehistoric American Southwest.* University of Utah Press. Salt Lake City.

Ubelaker, D.H.
1978 *Human Skeletal Remains: Excavation, Analysis, Interpretation.* Smithsonian Institution Press, Washington, D.C.

Valdez, Adella J.
1993 Macrobotanical Analysis and Interpretation from 42Ka1568: A Late Anasazi Pueblo in Southern Utah. Unpublished Master's thesis, Department of Anthropology, California State University, Long Beach, California.

Wade, W.A.
1967 Archaeological Investigations in Northwestern Arizona. Ms. Museum of Northern Arizona. Flagstaff.

Wagner, Gail E.
1982 Testing Flotation Recovery Rates. *American Antiquity* 47:127-132.

Walling, Barbara A. and Richard A. Thompson
1986 South Creek: Excavations at 42Ws1712. Ms. on file, Intersearch, Inc. Cedar City.

2004 *Archaeology of the Dead Raven Site.* Utah Cultural Resource Series No. 26, Grand Staircase-Escalante National Monument Special Publication No. 2.Salt Lake City.

Walling, Barbara A., Richard A. Thompson, Gardiner F. Dalley and Dennis G. Weder
1986 *Excavations at Quail Creek.* Bureau of Land Management Cultural Resource Series No. 20. Salt Lake City.

Walling-Frank, Barbara
1998 AZ B:1:35 (BLM) The Carling Reservoir Site. In *Excavation/Mitigation Report. Three Sites near Hildale, Utah: 42WS2195, 42WS2196, AZ B:1:35 (BLM) (Reservoir Site).* Compiled by Asa S. Nielsen, pp. 6.1-6.90. Baseline Data Research Report No. 98.8, Baseline Data, Orem, Utah.

Walters, Harry and Hugh C. Rodgers
2001 Anasazi and 'Anaasa'zi: Two Words, Two Cultures. *Kiva* 66 (3).

Waterworth, Robert M.R., and Eric Blinman
1986 Modified Sherds, Unidirectional Abrasion, and Pottery Scrapers. *Pottery Southwest* April: 4-6.

Watson, Patty Jo
1976 In Pursuit of the Past: A Comparative Account of Some Contemporary Flotation Techniques. *Mid-Continental Journal of Archaeology* 1(1):77-100.

Webb, Robert. H., Spence S. Smith and V. Alexander S. McCord
1991 *Historic Channel Change of Kanab Creek.* Grand Canyon Natural History Association Monograph No. 9

Welsh, S. L., N. D. Atwood, S. Goodrich, L. C. Higgins
1993 *A Utah Flora.* Brigham Young University, Provo, Utah.

Wenker, Chris T. (Editor)
2004 *Bryce Canyon National Park Archeology of the Paunsaugunt Plateau.* Intermountain Cultural Resources Management Professional Paper No. 69.Santa Fe.

Westfall, Deborah
1985 Archaeological Test Excavations at the Energy Fuels Nuclear, Inc. Vermilion Cliffs Project, Kane County, Utah. Prepared for the U.S. Nuclear Regulatory Commission by Abajo Archaeology. On file at the BLM, GSENM Hq. Kanab.

1987 *The Pinenut Site: Virgin Anasazi Archaeology on the Kanab Plateau of Northwestern Arizona.* Arizona Cultural Resource Series Monograph No.4. Bureau of Land Management. Phoenix.

Westfall, Deborah, William Davis and Eric Blinman
1987 *Green Spring: An Anasazi and Southern Paiute Encampment in the St. George Basin of Utah.* Cultural Resource Series No. 21. Utah Sate Office, Bureau of Land Management, U. S. Department of the Interior, Salt Lake City.

Whiting, A. F.
1939 Ethnobotany of the Hopi. Museum of Northern Arizona Bulletin No. 15.

Wilson, Dean
1985 Analysis of Ceramics Recovered During the Vermilion Cliffs Project. In Archaeological Test Excavations at the Energy Fuels Nuclear, Inc. Vermilion Cliffs Project, Kane County, Utah, Deborah A. Westfall, Abajo Archaeology.

Wise, Karen E.
1986 *Prehistoric Settlement Patterns and site plans on Little Creek Mountain and the Western Anasazi Region. Western Anasazi Reports* 3(3): 273-339.

Wood, W. R., and D. L. Johnson
1978 A Survey of Disturbance Processes in Archaeological Site Formation. In Advances in Archaeological Method and Theory, vol.1, edited by M. B. Schiffer, pp. 315-381. Academic Press, New York.

Woodbury, Richard B.
1954 Prehistoric Stone Implements of Northeastern Arizona. Papers of the Museum of American Archaeology and Ethnology, Vol. XXXIV. Cambridge.

Yanovsky, Ellas
1936 Food Plants of the North American Indians. United States Department of Agriculture, Miscellaneous Publication, No. 237. United States Government Printing Office, Washington D.C.

Young, James A., and Cheryl G. Young
1992 Seeds of Woody Plants in North America. Dioscorides Press, Portland, Oregon.

APPENDIX

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

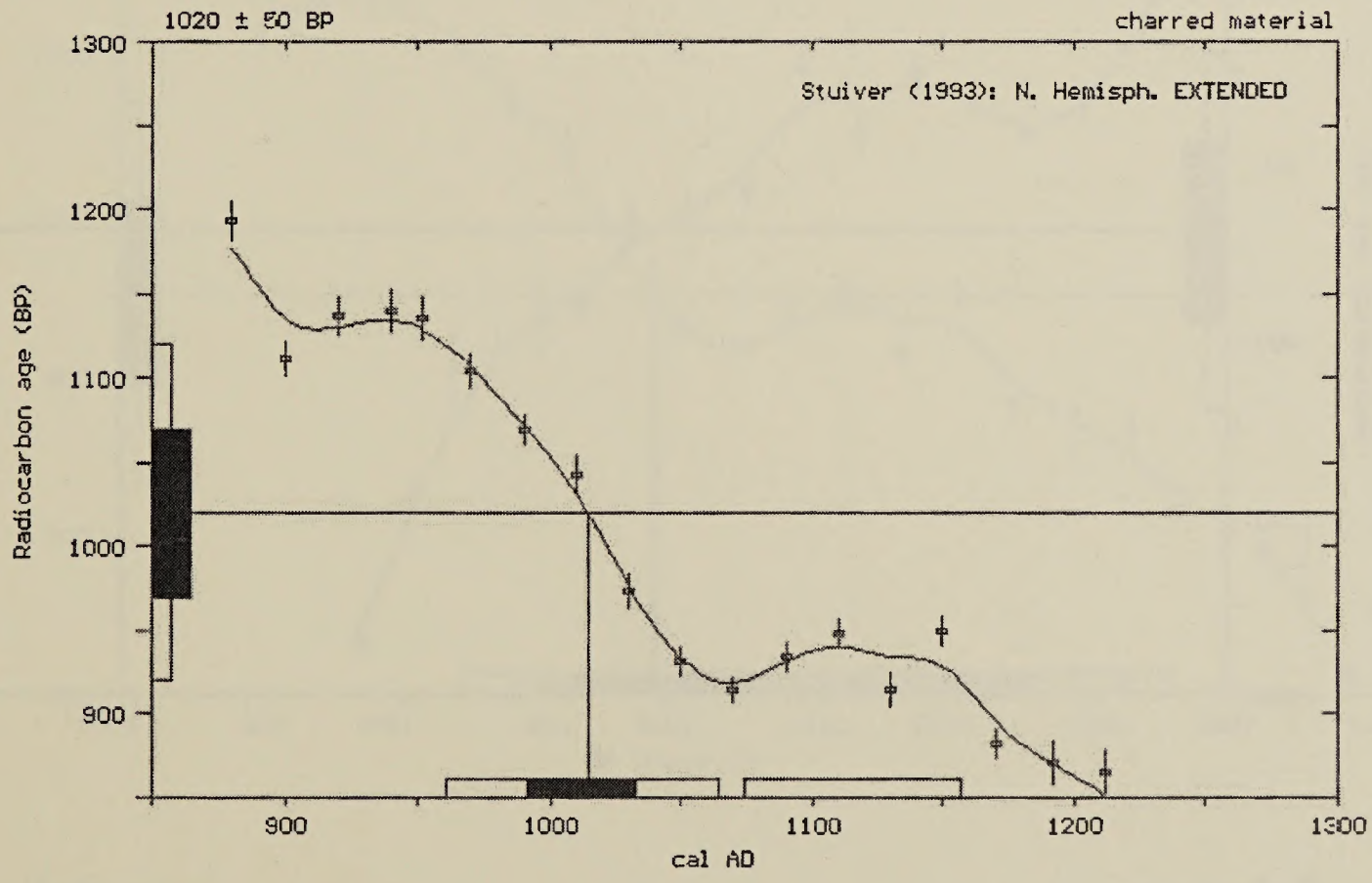
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77113
Conventional radiocarbon age*:	**1020 +/- 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 960 to 1065 and cal AD 1075 to 1155**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1015
1 sigma calibrated results: (68% probability)	cal AD 990 to 1035



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

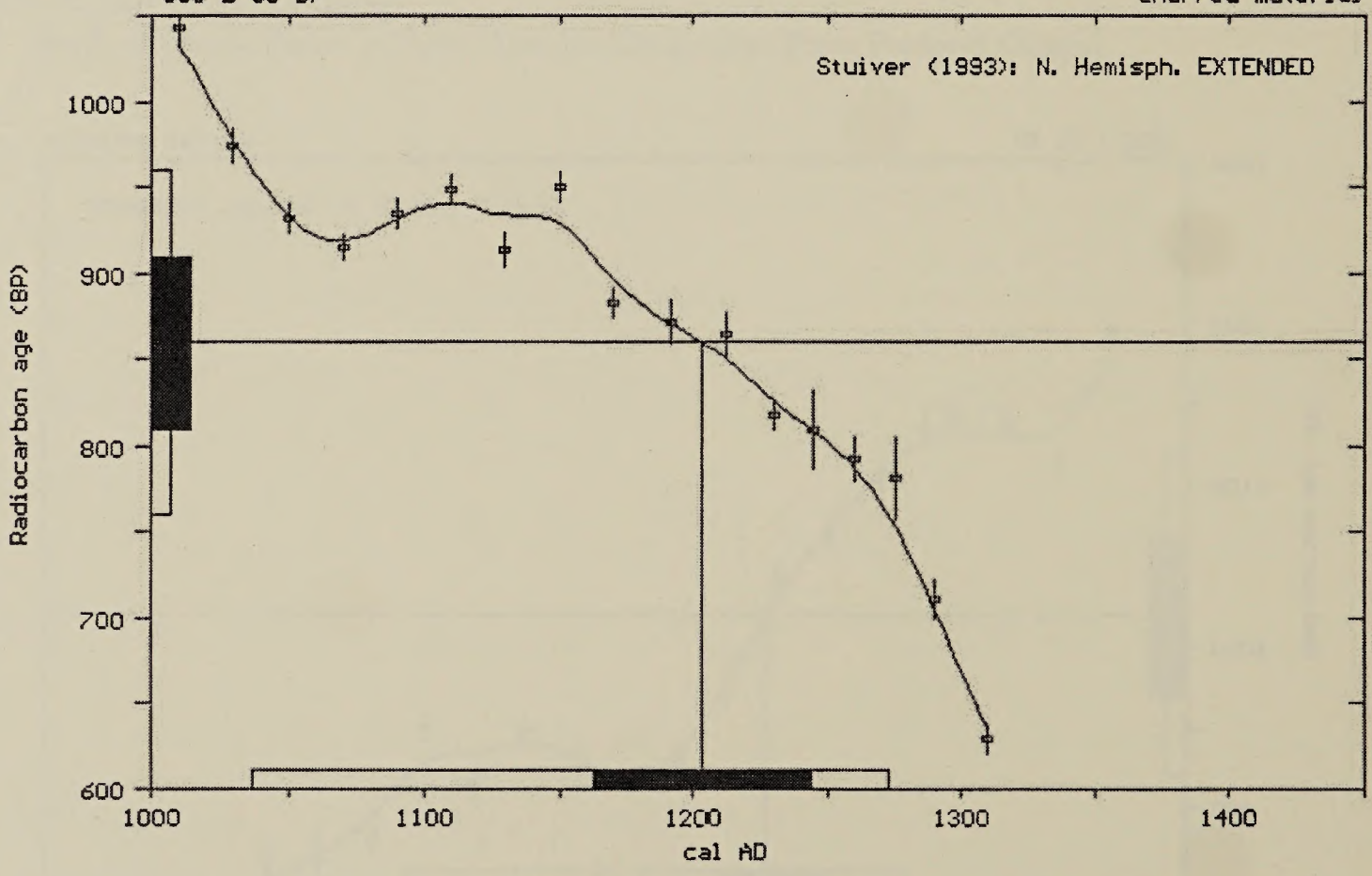
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-66335
Conventional radiocarbon age*:	**860 +/- 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1035 to 1275**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1205
1 sigma calibrated results: (68% probability)	cal AD 1165 to 1245



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

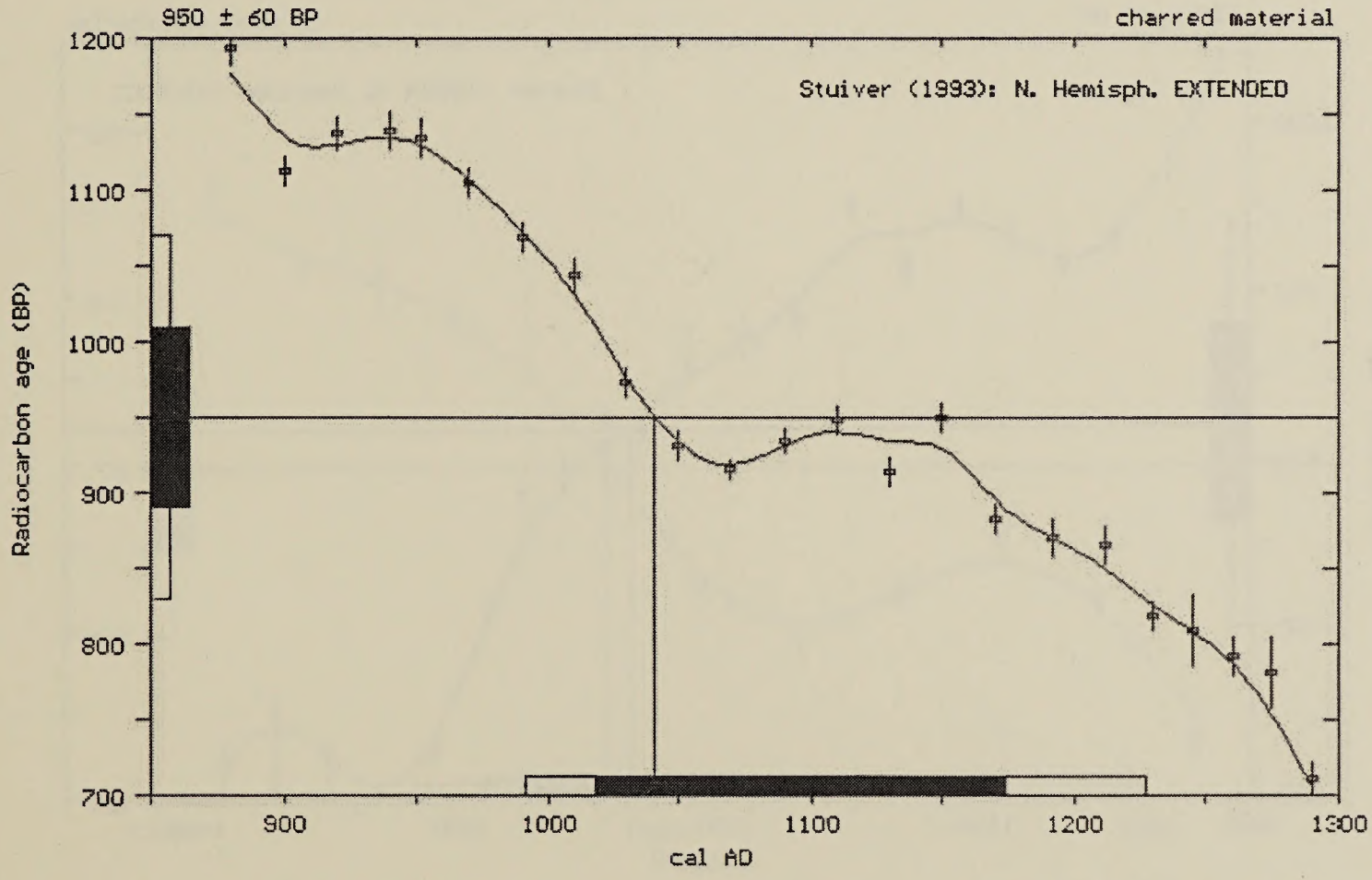
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77110
Conventional radiocarbon age*:	**950 +/- 60 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 990 to 1225**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1040
1 sigma calibrated results: (68% probability)	cal AD 1020 to 1175



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

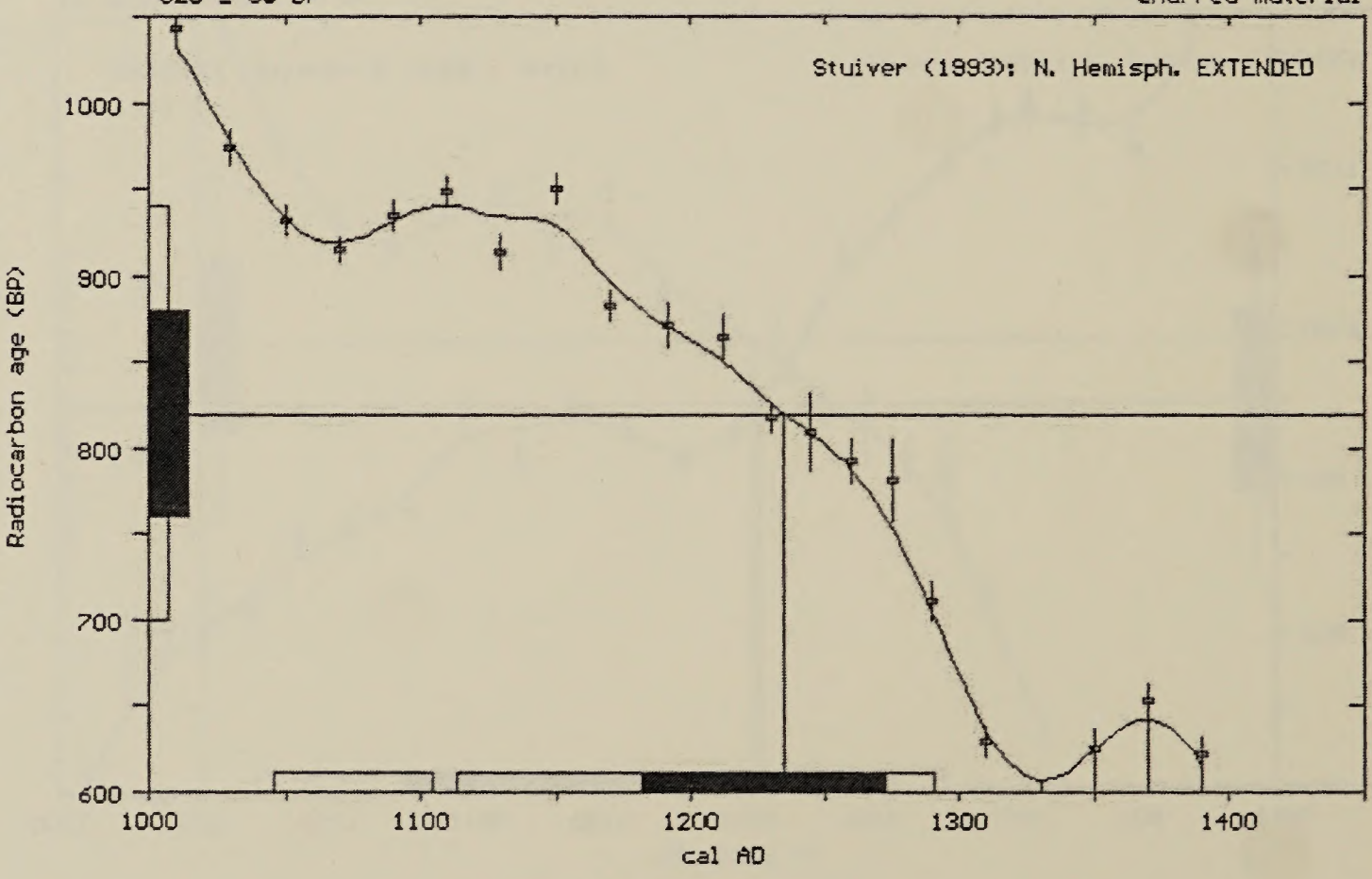
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77117
Conventional radiocarbon age*:	**820 +/- 60 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1045 to 1105 and cal AD 1115 to 1290**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1235
1 sigma calibrated results: (68% probability)	cal AD 1180 to 1275



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

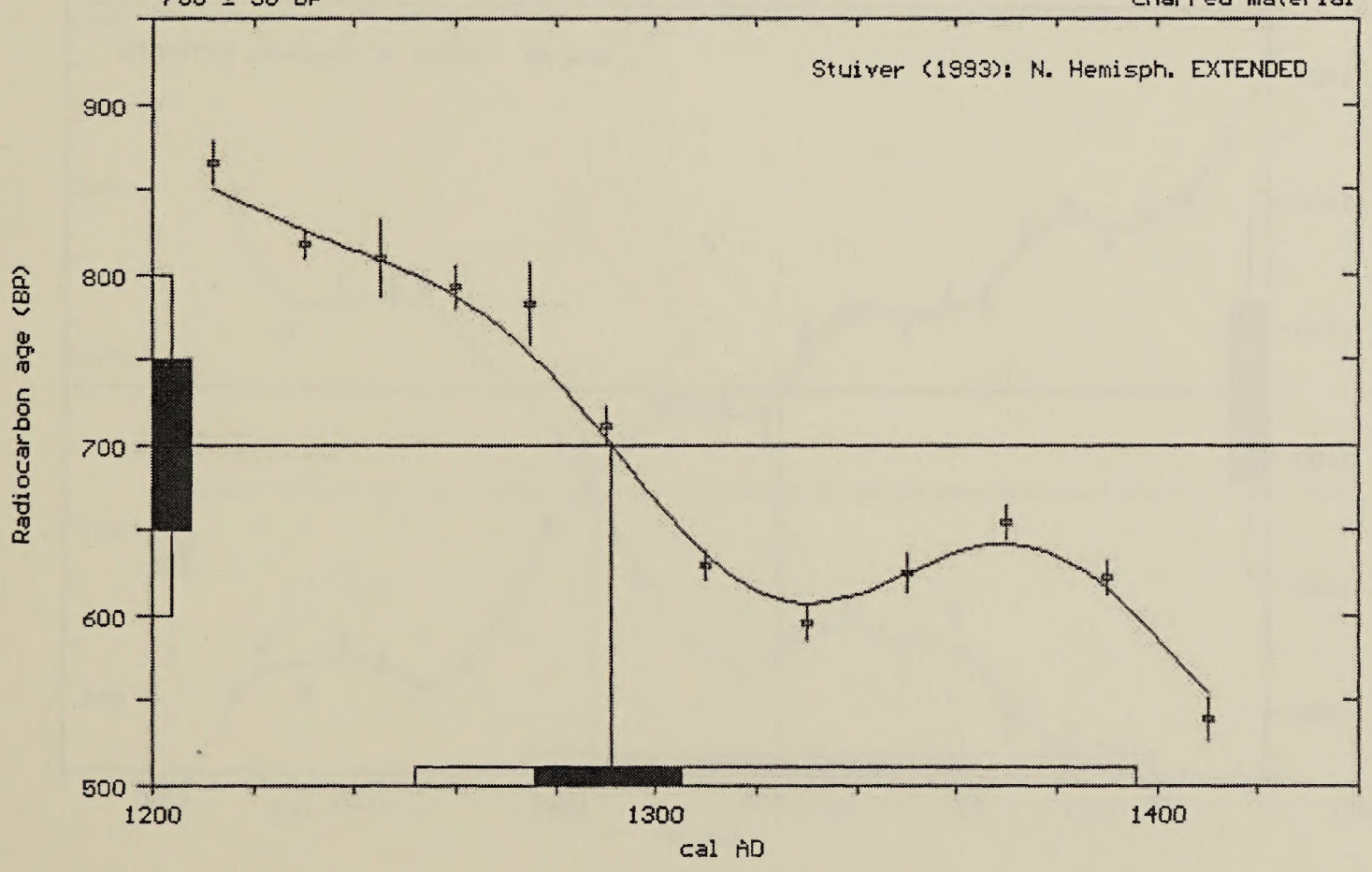
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77115
Conventional radiocarbon age*:	**700 +/- 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1250 to 1395**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1290
1 sigma calibrated results: (68% probability)	cal AD 1275 to 1305



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

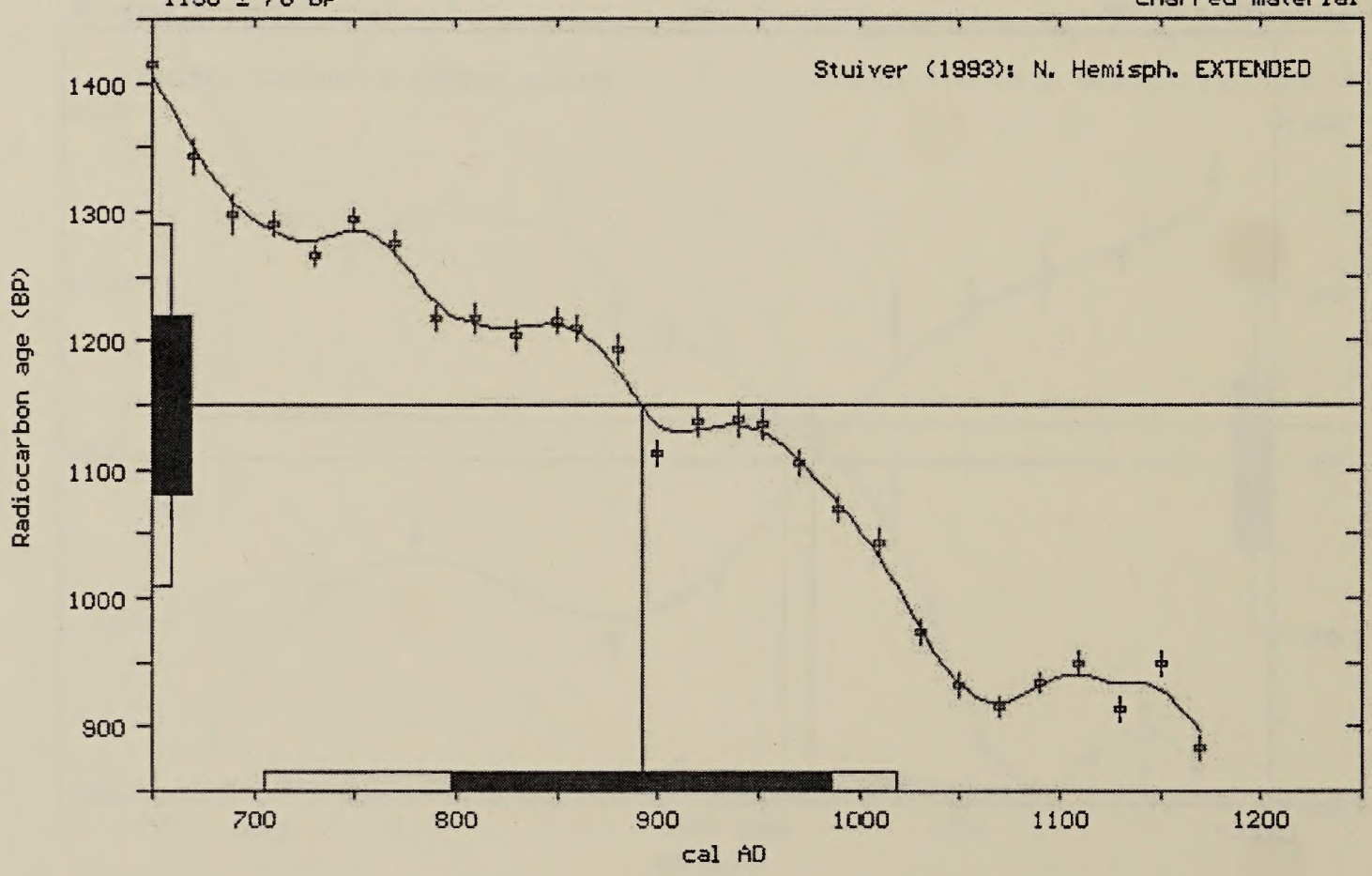
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77111
Conventional radiocarbon age*:	**1150 +/- 70 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 705 to 1020**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 890
1 sigma calibrated results: (68% probability)	cal AD 800 to 985



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

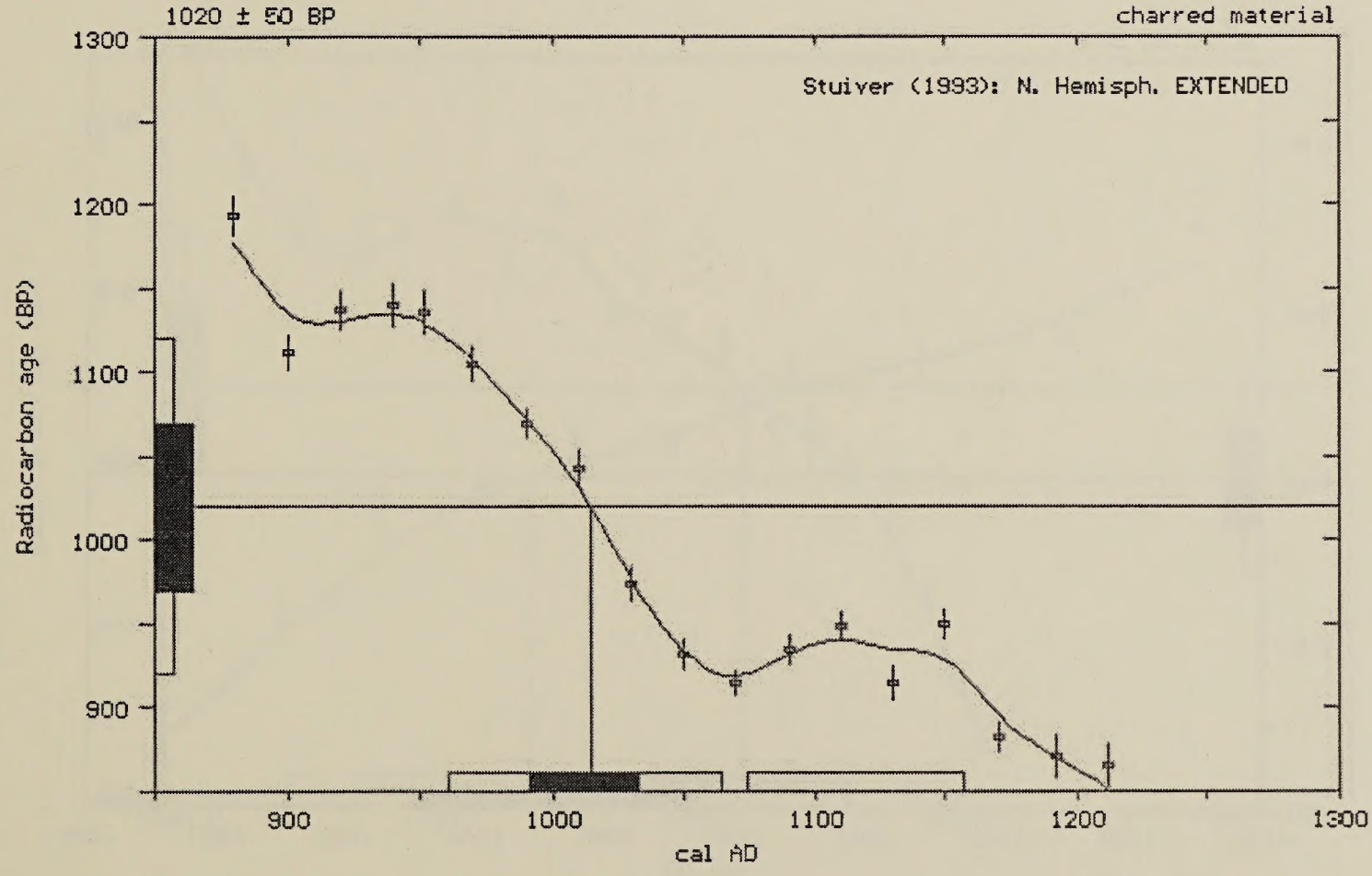
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-66334
Conventional radiocarbon age*:	**1020 +/- 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 960 to 1065 and cal AD 1075 to 1155**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1015
1 sigma calibrated results: (68% probability)	cal AD 990 to 1035



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

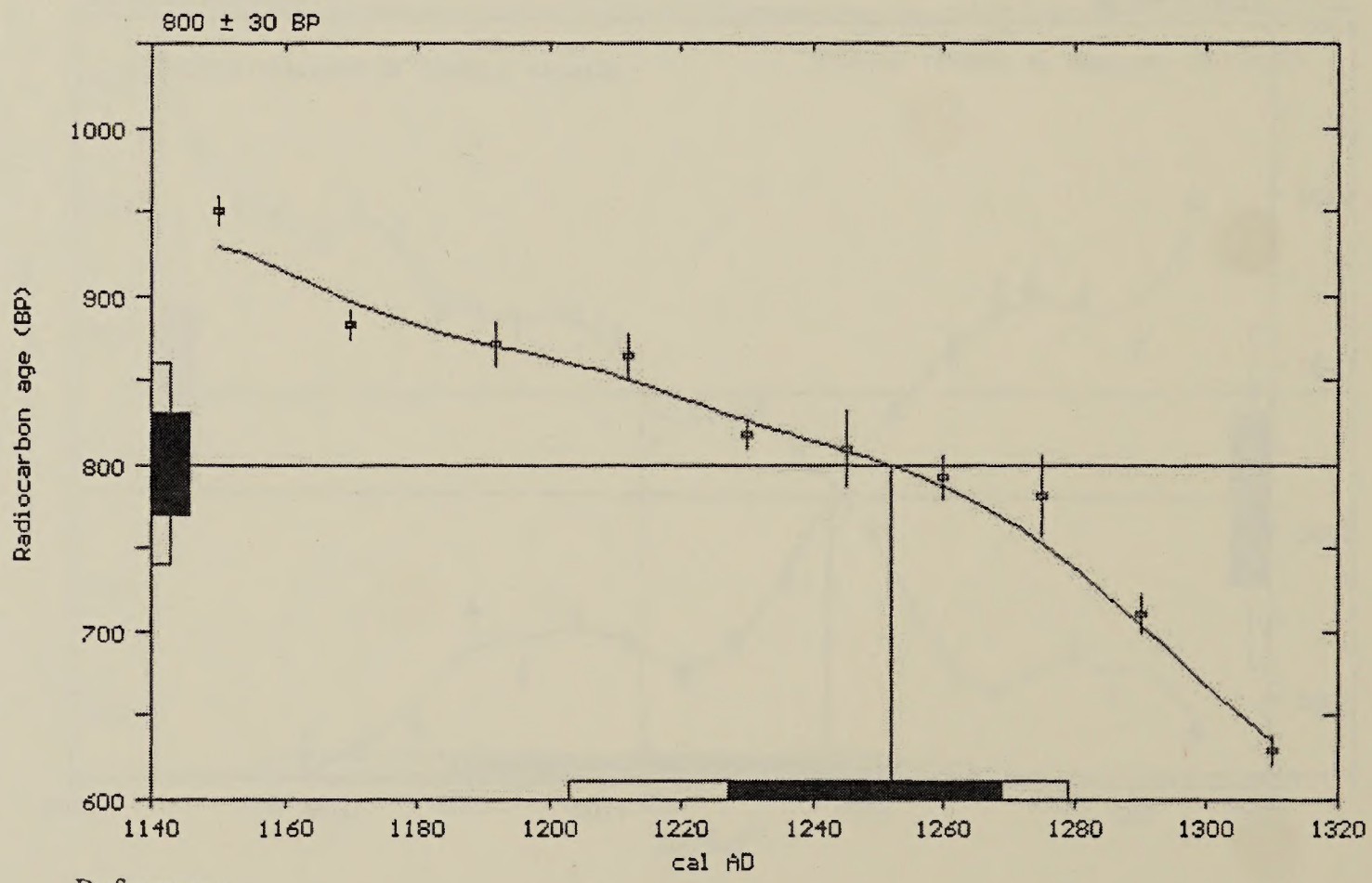
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-10:lab mult.=1)

Laboratory Number:	Beta-117940
Conventional radiocarbon age:	**800 ± 30 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1205 to 1280**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1250
1 sigma calibrated results: (68% probability)	cal AD 1225 to 1270



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 ■ Tel: (305)667-5167 ■ Fax: (305)663-0964 ■ E-mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

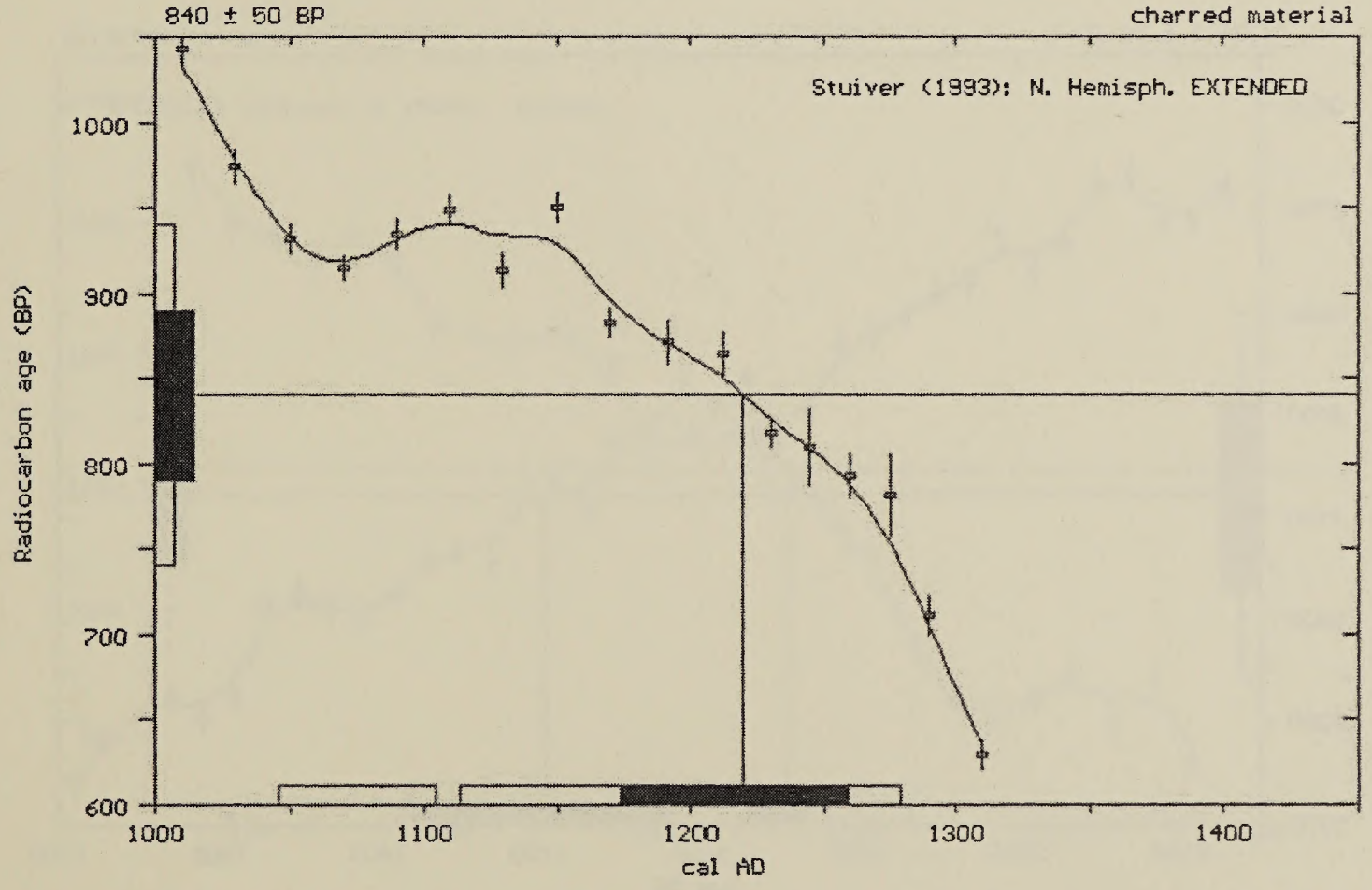
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77116
Conventional radiocarbon age*:	**840 +/- 50 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1045 to 1105 and cal AD 1115 to 1280**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1220
1 sigma calibrated results: (68% probability)	cal AD 1175 to 1260



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

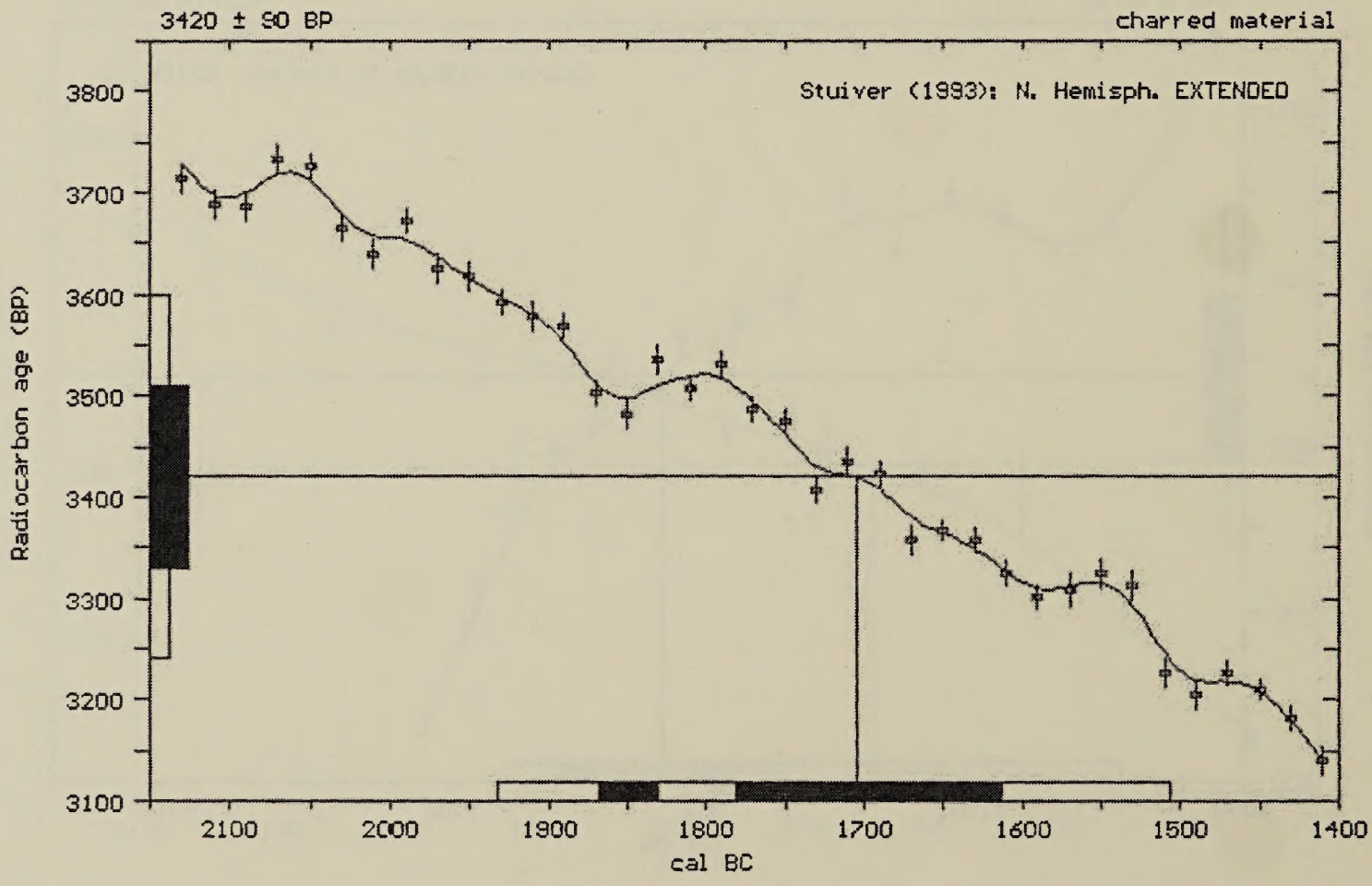
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77118
Conventional radiocarbon age*:	**3420 +/- 90 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 1935 to 1505**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 1705
1 sigma calibrated results: (68% probability)	cal BC 1870 to 1830 and cal BC 1780 to 1615



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

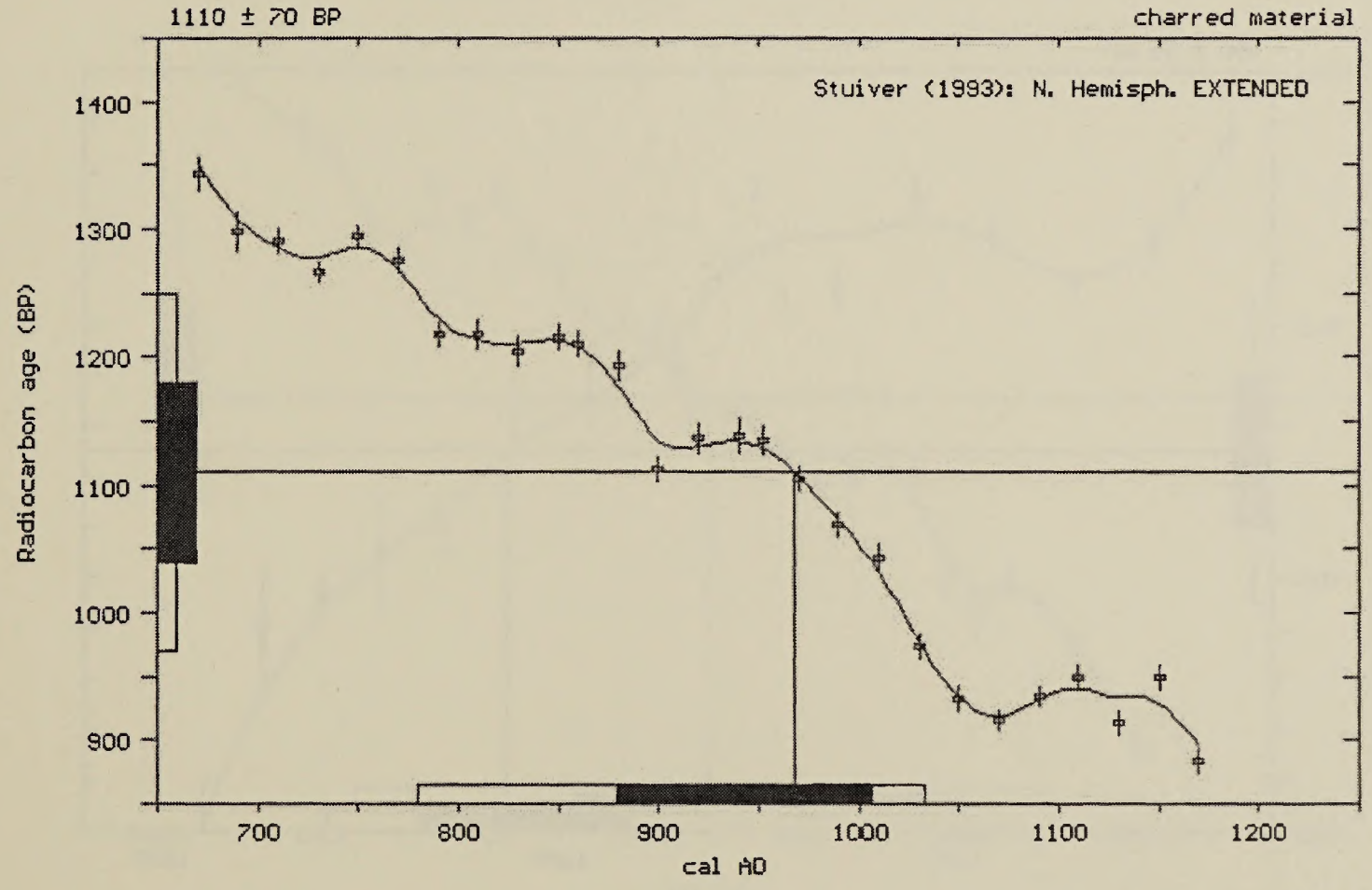
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77114
Conventional radiocarbon age*:	**1110 +/- 70 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 780 to 1035**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 970
1 sigma calibrated results: (68% probability)	cal AD 880 to 1005



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

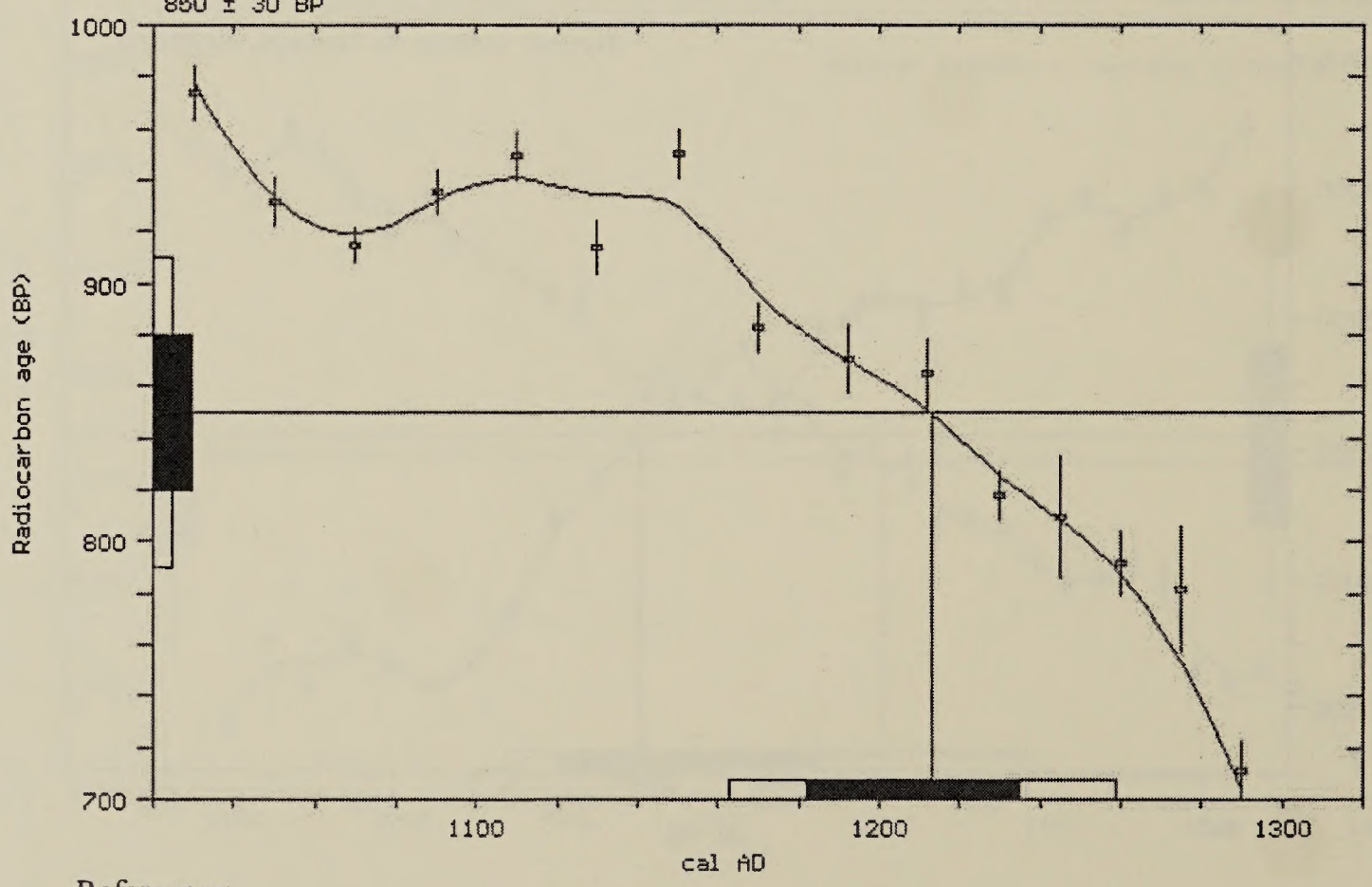
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-9.2:lab mult.=1)

Laboratory Number:	Beta-117941
Conventional radiocarbon age:	**850 ± 30 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1165 to 1260**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1215
1 sigma calibrated results: (68% probability)	cal AD 1180 to 1235



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 ■ Tel: (305)667-5167 ■ Fax: (305)663-0964 ■ E-mail: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

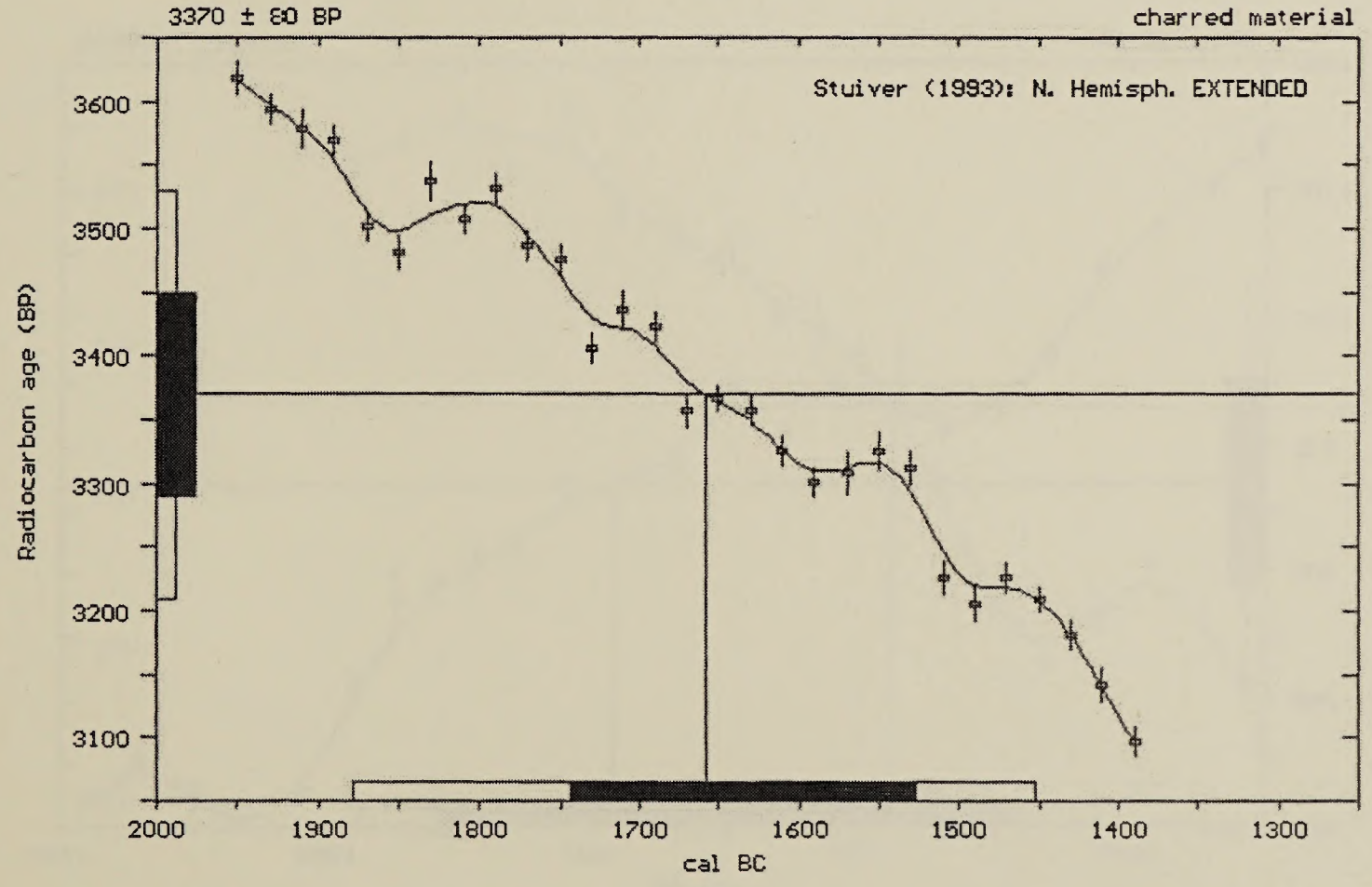
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77109
Conventional radiocarbon age*:	**3370 +/- 80 BP**
Calibrated results: (2 sigma, 95% probability)	**cal BC 1880 to 1450**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal BC 1660
1 sigma calibrated results: (68% probability)	cal BC 1745 to 1530



References:

Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155

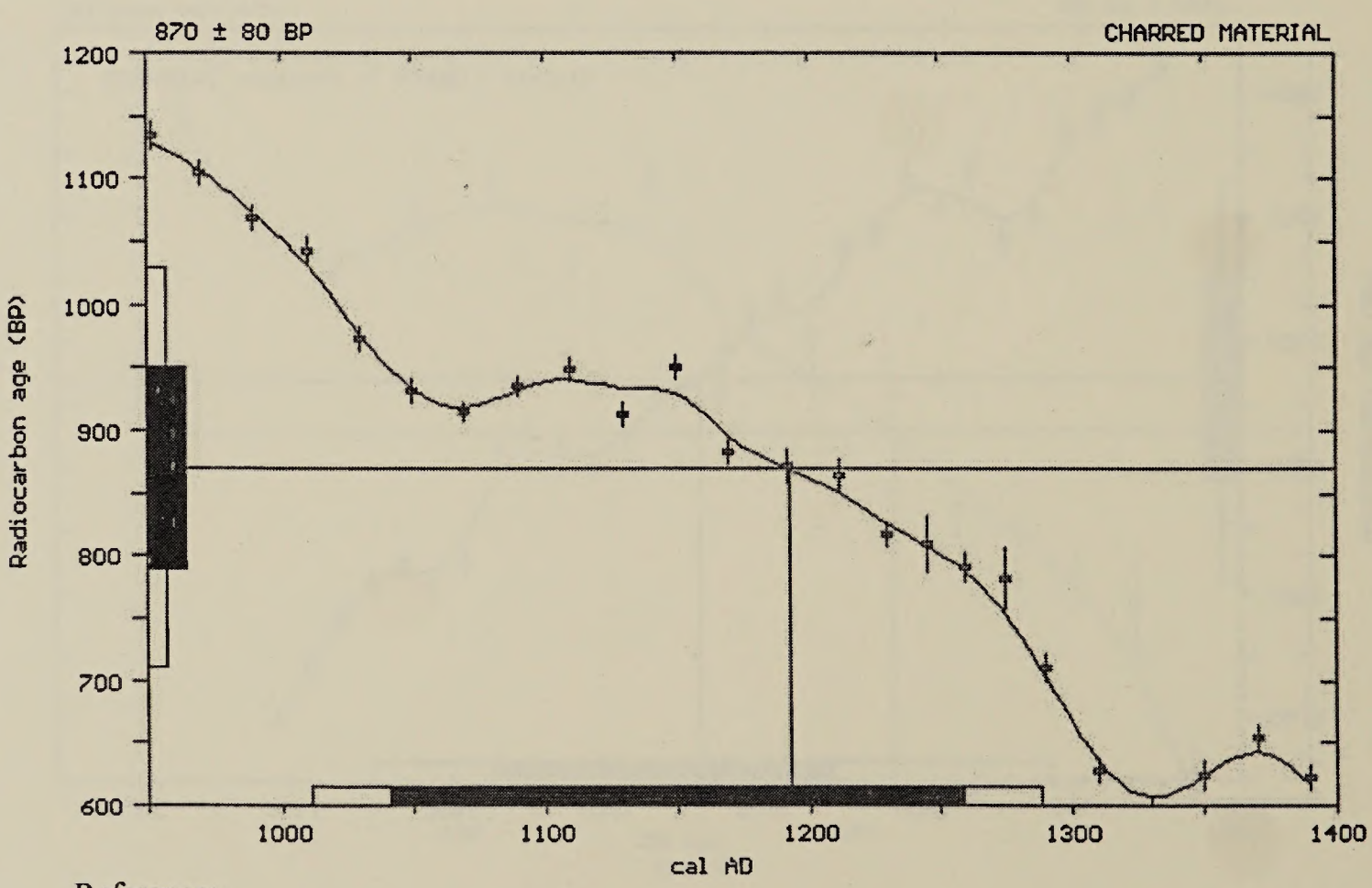
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables:C13/C12=-13.7:lab mult.=1)

Laboratory Number:	Beta-100262
Conventional radiocarbon age:	**870 ± 80 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1010 to 1290**

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1195
1 sigma calibrated results: (68% probability)	cal AD 1040 to 1260



References:

Pretoria Calibration Curve for Short Lived Samples
Vogel, J. C., Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

A Simplified Approach to Calibrating C14 Dates
Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Calibration - 1993
Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., 1993, Radiocarbon 35(1)

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

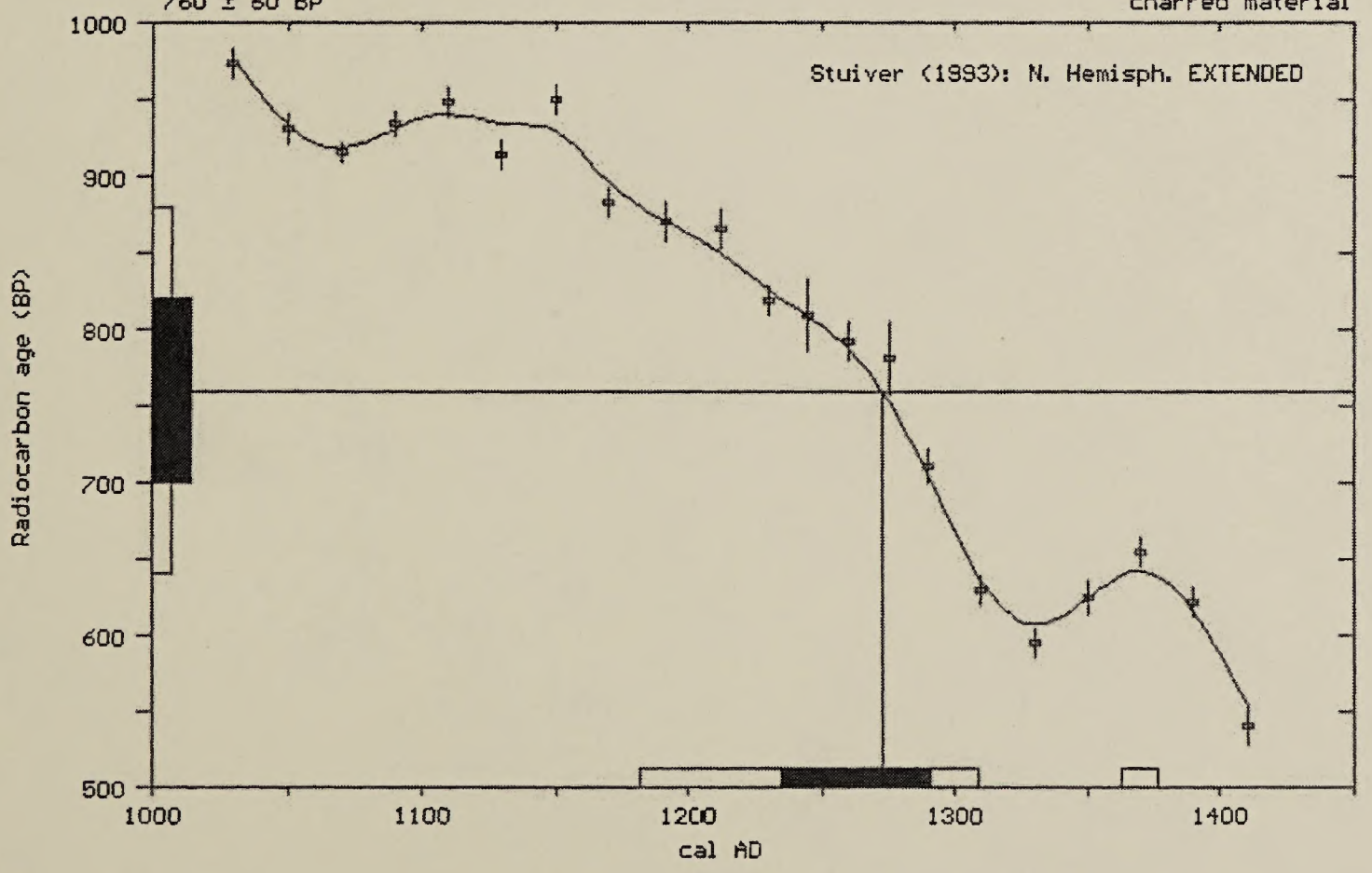
(Variables: est. C13/C12=-25.0:lab. mult=1)

Laboratory Number:	Beta-77112
Conventional radiocarbon age*:	**760 +/- 60 BP**
Calibrated results: (2 sigma, 95% probability)	**cal AD 1180 to 1310 and cal AD 1365 to 1375**

* C13/C12 ratio estimated

Intercept data:

Intercept of radiocarbon age with calibration curve:	cal AD 1275
1 sigma calibrated results: (68% probability)	cal AD 1235 to 1290



References:

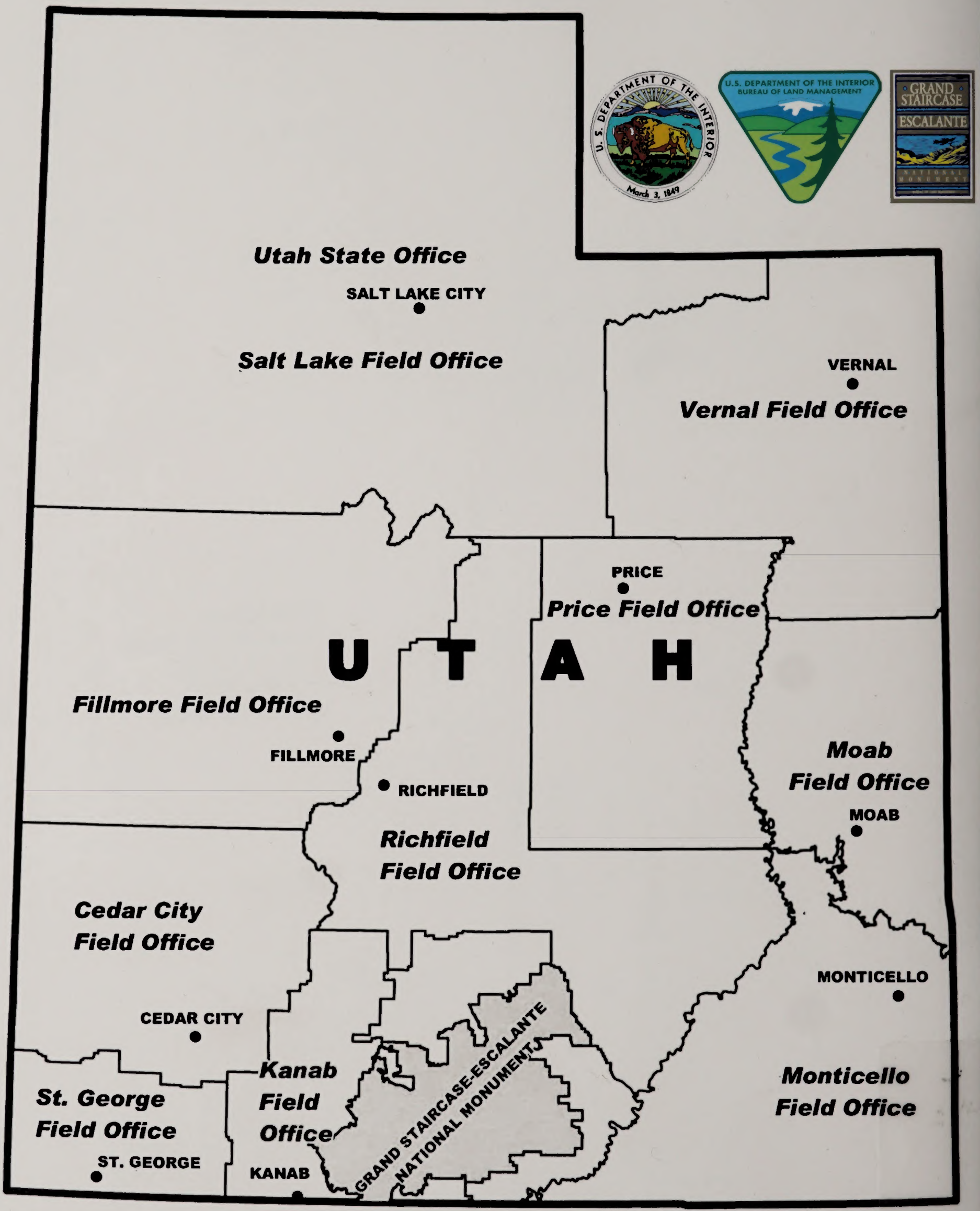
Vogel, J. C.,Fuls, A., Visser, E. and Becker, B., 1993, Radiocarbon 35(1), p73-86

Talma, A. S. and Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Stuiver, M., Long, A., Kra, R. S. and Devine, J. M., Radiocarbon 35(1)

Results prepared by:

Beta Analytic, Inc. 4985 S.W. 74th Court, Miami, Florida 33155


U.S. DEPARTMENT OF THE INTERIOR
March 3, 1849
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
GRAND STAIRCASE
ESCALANTE
NATIONAL MONUMENT
Utah State Office
SALT LAKE CITY
Salt Lake Field Office
VERNAL
Vernal Field Office
PRICE
Price Field Office
U T A H
Fillmore Field Office
FILLMORE
RICHFIELD
Richfield Field Office
Moab Field Office
MOAB
Cedar City Field Office
CEDAR CITY
MONTICELLO
Kanab Field Office
KANAB
GRAND STAIRCASE-ESCALANTE NATIONAL MONUMENT
St. George Field Office
ST. GEORGE
Monticello Field Office